Jersey City New Passenger Station, N. Y. L. E. & W. R. R.

Designed and Built by the Phœnix Bridge Co., Phœnixville, Pa.

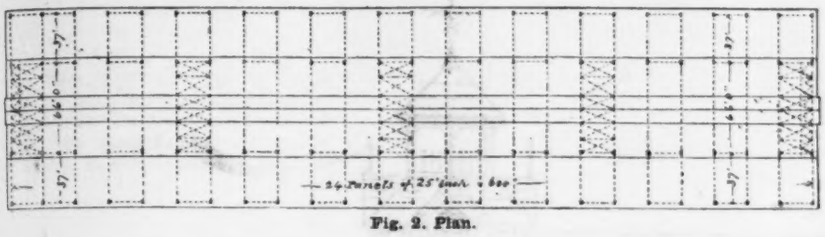


Fig. 2. Plan.

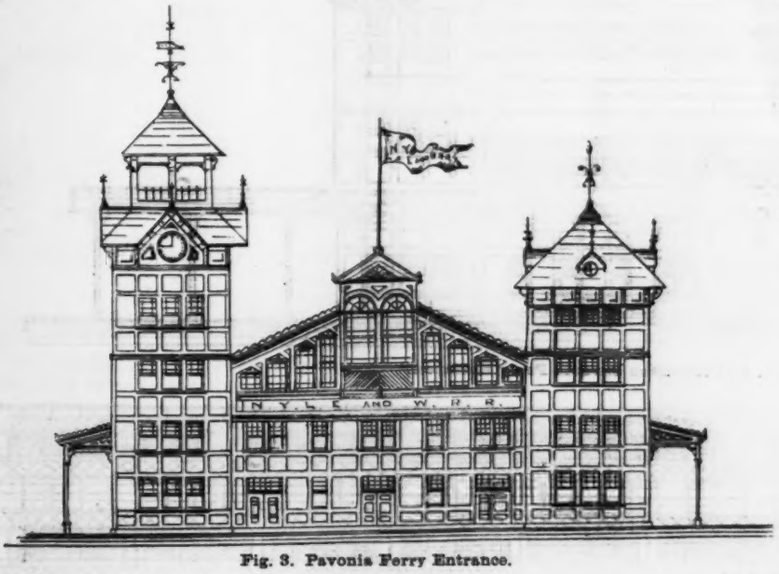


Fig. 3. Pavonia Ferry Entrance.

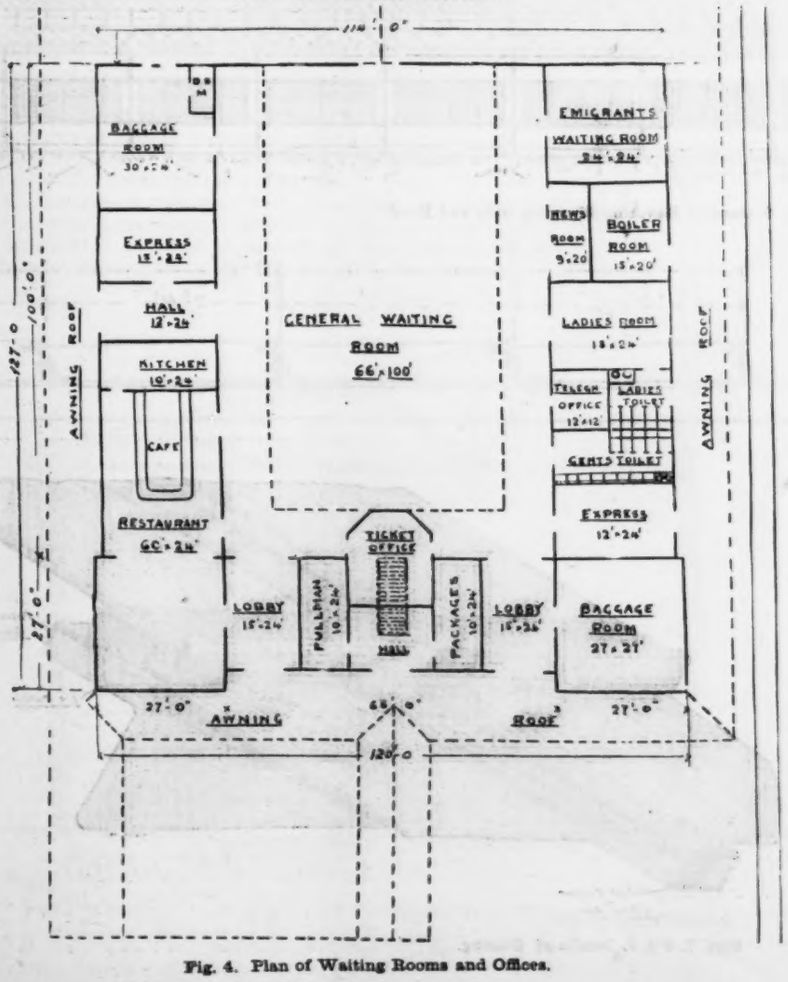


Fig. 4. Plan of Waiting Rooms and Offices.

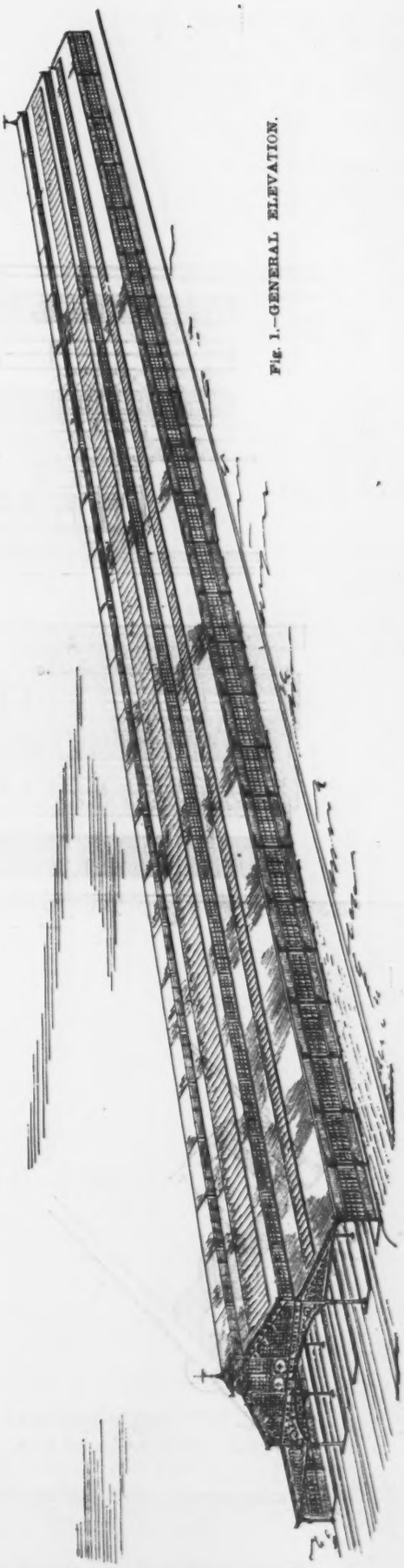


Fig. 1.—GENERAL ELEVATION.

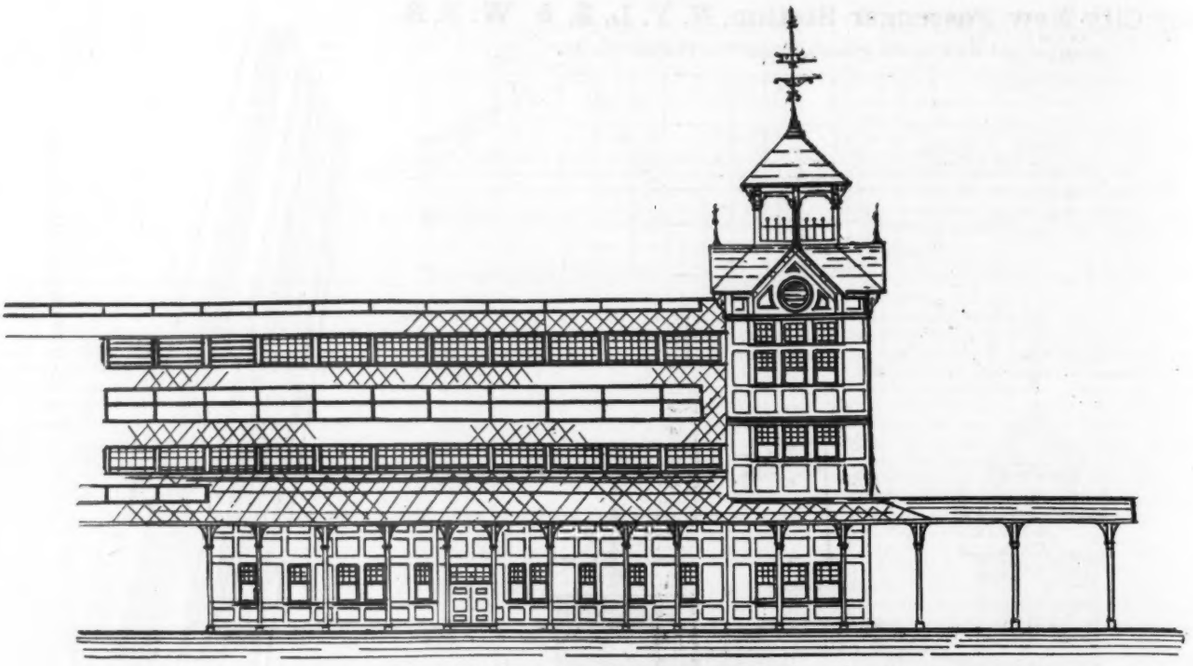


Fig. 5. Side Elevation Pavonia Ferry Entrance.

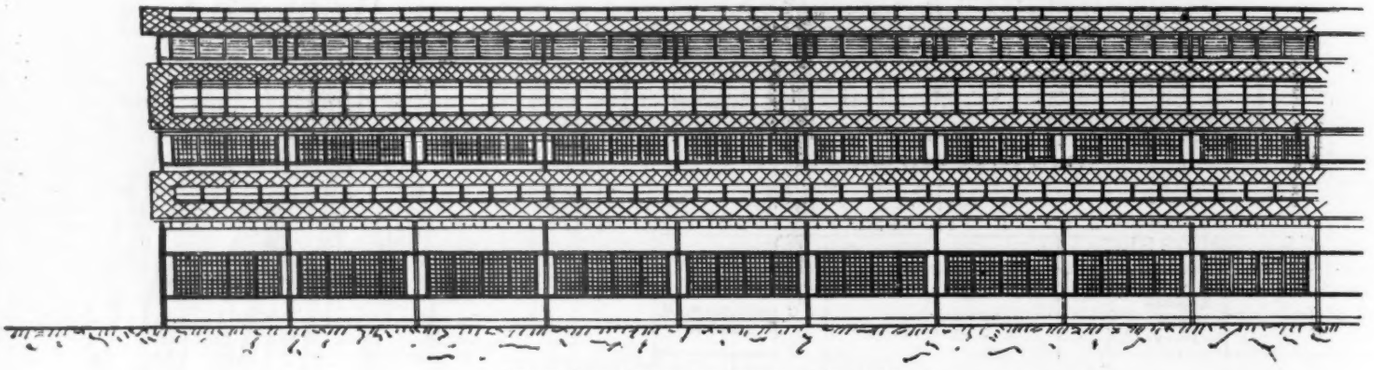
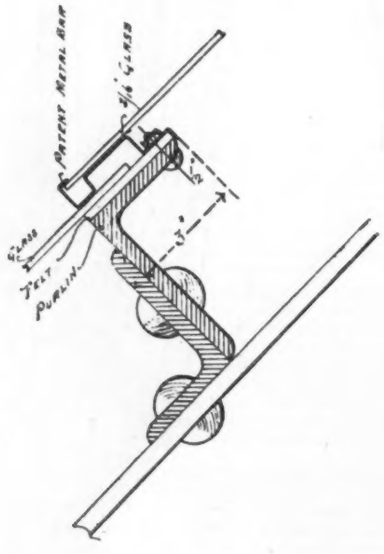
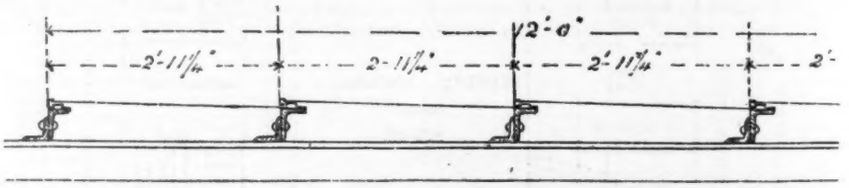
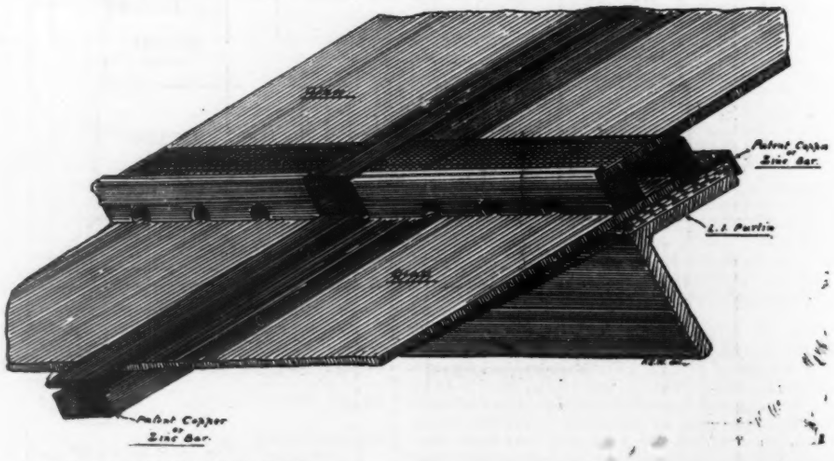


Fig. 6. General Elevation Showing Side and Roof.







Figs. 7. 8 & 9. Details of Glazing.

The New York, Lake Erie & Western Railway Passenger Station, Jersey City.

This Station, which is being built by the Phœnix Bridge Co., after its own designs, is to be one of the largest passenger train sheds in this country. It is located on the site of the old depot at the Pavonia terminus of the railway.

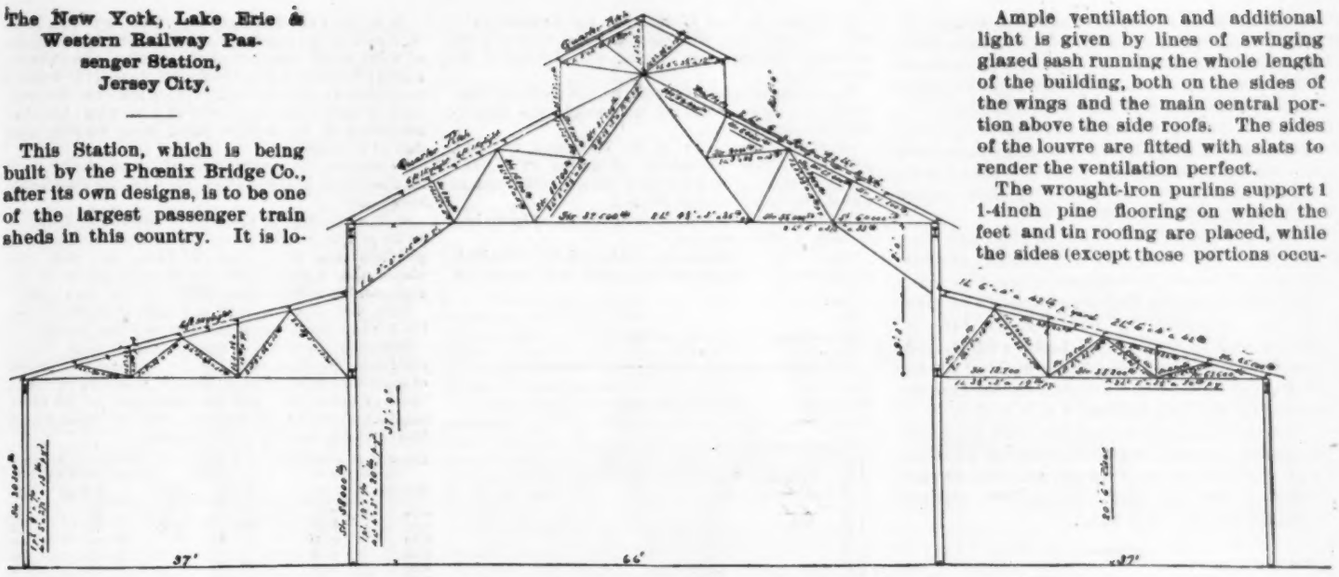


Fig. 10. Stress Diagram.

The building occupies a rectangular area 600 feet long by 140 feet wide, and covers eight tracks, which are arranged in pairs so as to allow free exit and entrance simultaneously to all trains coming and going. The building is divided into one main central portion 66 feet wide, flanked by two wings each 37 feet wide.

Fig. 1 shows the general elevation and entrance for the trains at the west end. The waiting rooms and offices, Fig. 3, 4 and 5, are at the opposite end of the building.

Figs. 10 and 11 show the stress sheet and roof trusses.

The principals, rafters, purlins and all supporting columns are of wrought-iron. The ground plan, Fig. 2, shows the arrangement of the twenty-five principals 25 feet apart with the five braced panels and wind trusses at the ends of the central portion. All rafters are built of 6 by 4-inch angles, and all members of the principals are of angle iron. The bracing and general construction show the building to be remarkably well adapted to its purpose, possessing as it does great stiffness and strength combined with a light and graceful appearance. The highest point of the roof is about 60 feet above the level of the rails.

The building is lighted by four lines of Rendle's patent sky-light running its entire length. The line on each pitch of the main roof is 12 feet wide, and that on each of the side portions 6 feet wide. There are thus 21,600 square feet of glass in the entire roof.

Ample ventilation and additional light is given by lines of swinging glazed sash running the whole length of the building, both on the sides of the wings and the main central portion above the side roofs. The sides of the louvre are fitted with slats to render the ventilation perfect.

The wrought-iron purlins support 1 1-4inch pine flooring on which the feet and tin roofing are placed, while the sides (except those portions occupied by the glazing) are closed by pine sheathing.

The lighting above referred to is a Rendle patent "Acme" principal, Figs. 7, 8 and 9, which has been adopted on the following railway depot structures: Grand Central, New York City, Cincinnati Union Depot, Cleveland Depot and the New Erie Depot as here illustrated. On inspection it will be clearly seen

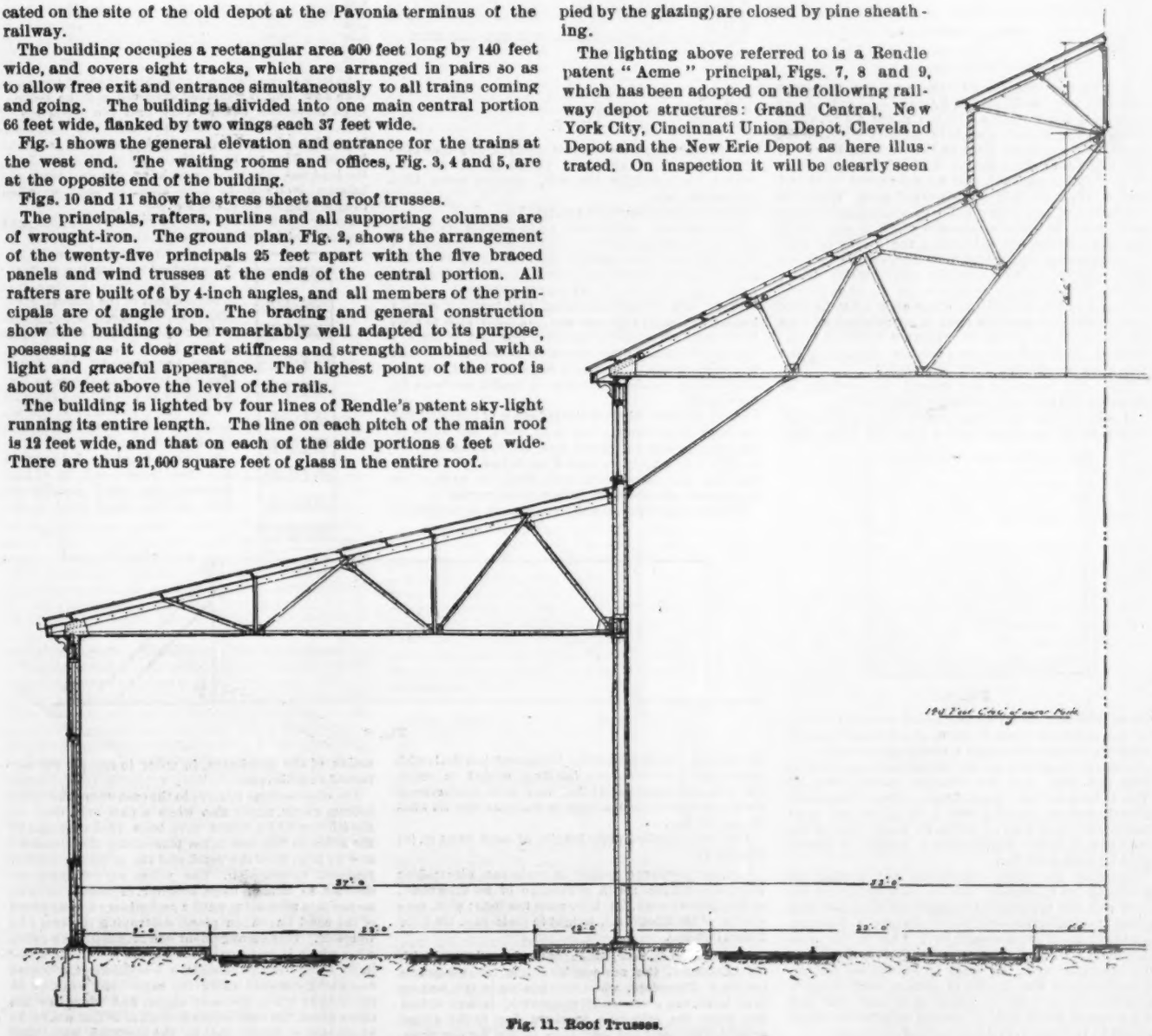


Fig. 11. Roof Trusses.

that the system is one combining simplicity with economy; there are no repairs, as the glass and metal bars constitute the system without putty; it therefore especially commends itself to railway companies, engineers and contractors. The Rendles of Great Britain have covered vast areas on this perfect system, among which we can mention Carlisle Citadel Station with 322,000 square feet of glass, Gordon street Station, Glasgow, 130,000 feet, etc.

Seventy-eight passenger trains are run out from the company's terminus, distributed as follows: Twenty-seven on the main line, fifteen on the Northern Railway of New Jersey, fourteen on the Newark branch, twelve on the Greenwood Lake and ten on the New Jersey and New York, making a total of seventy eight. The mileage owned and operated by the Erie Railway Co. is 2173.

The structure when complete, will place the company's terminal facilities on an equality with the best in the country, and people patronizing the road and its branches will appreciate the long felt want.

Sand as a Foundation.

Compiled for ENGINEERING NEWS.

BY W. W. CURTIS, C. E.

(*Concluded from page 316.*)

Let us consider in the arch $a\,p\,b$, the pressures upon the two small prisms $b\,f\,e$ and $b\,f\,h\,g$; both are pressed to the opening $a\,b$ by the prism $h\,g\,c\,k$, which tends to slide along $b\,c$, while in another direction the prism $b\,f\,e$ is pressed towards the opening by $e\,f\,n\,o$, and $b\,f\,h\,g$ is retained against $b\,c$ by the weight of $h\,m\,n$. It is natural then, that $a\,b\,p$ detaches itself and leaves after its fall, the observed arch. When the platform with the piece $a\,b$ (Fig 4), commences to move away from the box, the pressure which it supports is gradually diminished until, when the grains of sand by rearranging themselves have formed the arch, $a\,b$ only supports the weight of the prism which is detached. "Evidently, reasoning as for the small prisms $b\,f\,e$ and $b\,f\,h\,g$, the stability of the arch must become less, in proportion as the apex is approached, and the distance from the points of support $a\,d$ and $b\,c$ is increased. In fact, it is at the apex that the arch gives way when the opening $a\,b$ is increased."

While the reasoning just quoted may perhaps be disputed, the facts are unchanged thereby.

16. The small arches being unable to maintain themselves, when the opening in the box was wider than

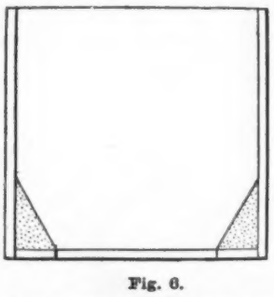


Fig. 6.

0.35 m. it became desirable to discover the law followed by the pressure exerted upon the movable bottom, when the opening was given a width of 0.4 m. (15¾").

In this case, as fast as the weights were removed from the scale pan, the pressure exerted upon $a\,b$ (Fig. 4) became less, until finally, when it separated from the bottom, drawing away in its fall all the sand except the two prisms $a\,b\,c$ (Fig. 6), there was in the scale pan to secure equilibrium, a weight of thirty-eight kilograms (84 lbs.)

Repeating the same experiment and loading the sand with 200 kilograms (440 lbs.) the weight in the scale pan was thirty-six kilograms (79 lbs.); and with a load of 400 kilograms (882 lbs.) the weight in scale pan was thirty-three kilograms (72 lbs.). That is, the pressure upon $a\,b$ at moment of separation decreased as the surcharge upon the sand increased; so that although the arch was unable to sustain itself alone, it nevertheless, in order to relieve of its load that part of the bottom which yielded, exerted an influence which tended to increase with the amount of surcharge.

To judge of the influence of the height of sand in the box, upon the pressures.

17. A box 1 m. long, 0.5 m. wide and 0.8 high (3¼" × 1.6' × 2.6') was filled with sand and the sixteenth experiment was repeated, leaving the opening of the same size.

With the sand without surcharge, the platform separated from the box when the scale weight was twenty-five kilograms (55 lbs.).

Sand with surcharge of 100 kilograms (220 lbs.), scale-weight was twenty-six kilograms (57 lbs.) and with surcharge of 200 kilograms (441 lbs.) scale-weight was thirty-nine kilograms (86 lbs.).

Reducing the height of the sand contained in the box to 0.3 m. (1') there results:

Sand without surcharge, scale-weights required, thirty-seven kilograms (81 lbs.); sand with surcharge

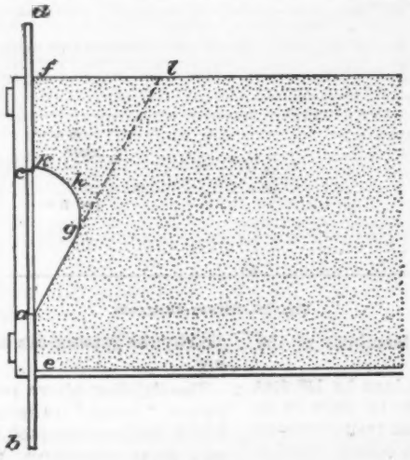


Fig. 7.

of 100 kilograms, scale-weights required, fifty-nine kilograms (130 lbs.); sand with surcharge of 200 kilograms, scale-weights required, seventy-seven kilograms (169 lbs.).

With height of sand of 0.2 m. (7⅞")—

Sand without surcharge, scale-weights required, thirty-one kilograms (68 lbs.); sand with surcharge of 100 kilograms, scale-weights required, sixty-five kilograms (143 lbs.); sand with surcharge of 200 kilograms, scale-weights required, 103 kilograms (227 lbs.).

From this it was concluded that below a certain height, the sand in the box was no longer able to arch itself and thus relieve of pressure that part of the bottom which yields to the primitive pressure, and that beyond a certain limit, which varies probably with the width of the opening, increase of height produces no more effect.

18. To discover whether the influence of the height of the sand would remain the same, when the width of the opening was increased, this width was made 0.75 m. (29½") the length remaining as before. 0.5 m. (19¾"). The box was then filled with sand for 0.3 m. (1') in height and, proceeding as before, there results:

Without surcharge, weight in scale pan at moment o

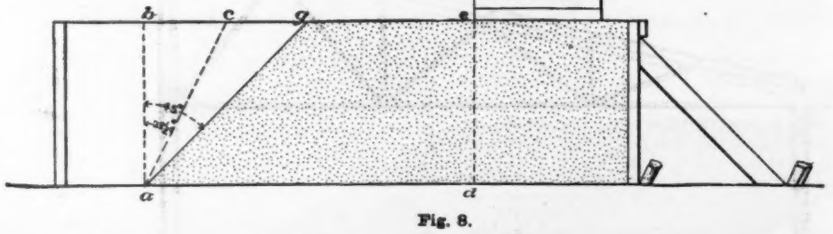


Fig. 8.

separation was ninety-seven kilograms (213 lbs.); with surcharge of 200 kilograms (441 lbs.), weight in scale-pan was 235 kilograms (518 lbs.); and with surcharge of 400 kilograms (882 lbs.), weight in scale pan was 412 kilograms (908 lbs.).

This was repeated with height of sand of 0.6 m. (2') resulting:

Without surcharge, weight in scale-pan, ninety-four kilograms (207 lbs.); with surcharge of 200 kilograms, weight in scale-pan, 111 kilograms (244 lbs.); with surcharge of 400 kilograms, weight in scale-pan, 150 kilograms (330 lbs.).

Also with 0.8 m. (2.62') height of sand surcharged with 200 kilograms, the scale-weight was 119 kilograms (262 lbs.). Therefore, when the opening in the bottom is so large, the pressure at moment of failure differs less from the primitive pressure due to the actual weight of the sand and load, than in the former cases. The influence which the height of sand exerts, appears to diminish less rapidly.

In all the experiments of Capt. Niel, (numbers 12, 15, 16, 17 and 18), the surcharge was placed upon a platform of wood, a little smaller than the opening in the bottom. It was remarked that, in loading the sand, if the weights were placed at the extremities of the platform, the pressure on the bottom was decreased somewhat: the augmentation of the friction being more sensible than that of the load.

To discover the modifications of the pressures, due to the dimensions of the platform, the following experiments were made:

19. The opening in the bottom remaining 0.75m. in width and the height of sand being 0.6m. (2'), a wooden platform 0.96m. (37⅞") long and 0.48m. (19") wide, was placed upon it and loaded with 400 kilog. (882 lbs.): the platform fell with 107 kilog. (235 lbs.) in the scale pan.

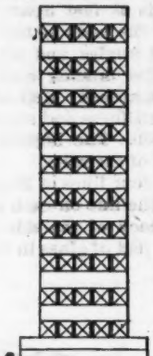
This was repeated with a height of sand of 0.2m. (7⅞"), when the platform fell with 100 kilog. (220 lbs.)

Reducing the width of the opening to 0.4m. (15¾") sand 0.4m. deep was placed in the box and the length of the platform was varied; always retaining the same width of 0.48m. (19"), and the same load of 200 kilog. (441 lbs.), except in the first one, when it was nothing. The following results were obtained:

Length of platform on the sand.		Load on same		Weight in balance when platform fell.	
Metres.	feet.	kilog.	lbs.	kilog.	lbs.
0.96	3.15	0	0	37	82
0.96	3.15	200	441	37	82
0.80	2.62	"	"	37	82
0.75	2.46	"	"	31	68
0.65	2.14	"	"	32	70
0.60	1.97	"	"	32	70
0.55	1.80	"	"	33	73
0.50	1.64	"	"	33	73
0.45	1.48	"	"	34	75
0.40	1.31	"	"	38	84
0.35	1.15	"	"	41	90
0.30	0.98	"	"	45	99
0.25	0.82	"	"	53	117
0.20	0.66	"	"	92	203

As long as the platform sustaining the load was more than 0.6m long, it remained unmoved, and the balance in its movement carried away only the prism $a\,b\,c\,d$ (Fig. 5); but when this length became less than 0.6m. long, the platform, with its load, descended with the balance. The upper platform being 0.6 m. (2') long, the load was increased to 400 kilog. (882 lbs.), when the balance started 32 with kilog. (70 lbs.), as when the load was 200 kilog. (441 lbs).

Again, the upper platform remaining 0.6 m. long, and the load being 200 kilog. the thickness of sand was reduced to 0.2 m. (7⅞"), when the balance started with 36kilog. (79 lbs).



We conclude from the above that "when a part of the bottom gives way, the surcharge is supported only upon a breadth nearly equal to that of the part of the bottom which has yielded." This fact it was important to establish, so that a property should not be attributed to the sand, due only to the inflexibility of the platform suporpting the surcharge.

It does not appear however that this result could be of long duration, the sand, running out little by little, must yield to the action of the surcharge, in order to recover the surface of equilibrium.

The observations relative to the case where the entire bottom yields, apply also when a part only does so; the friction which would have been produced against the sides, in this case takes place along the slopes $a\,d$ and $b\,c$ (Fig. 5), of the sand, and the adhesion must be replaced by cohesion. The prism $a\,b\,c\,d$ which endeavors to detach itself, however, is unable to commence this movement until a preliminary derangement of the sand has taken place, destroying its form of a voussoir. This derangement commences in the prism $a\,b\,p$, which is less sustained than the rest of the mass; in proportion as the opening $a\,b$ is enlarged, cohesion remaining constant under the same load, rupture in the vicinity of $p\,m$ becomes easier, and when this has taken place, the case becomes similar to that where the whole bottom yields; that is, the pressure upon that part of the bottom which fails being lessened by the friction only, the pressures increase with the load.

Whatever the property in virtue of which sand will arch itself above the portion of the bottom, limited in extent, which yields, it is still of very great importance in the employment of sand in foundations. The movements of superstructures being very slow, the pressures supported by different parts of the base depart little from the primitive ones; hence as soon as a part yields, it will be relieved at the expense of those surrounding; and there will be established a multitude of small arches, of which the piers are supported upon the more resisting parts of the bed, until this bed having taken such a form as to make the resistances the same throughout, the mass of sand changes its shape to accord therewith and is supported equally at all points. Or as Captain Moreau expresses it:—

"Whatever may be the original pressures, when a portion of the bottom commences to give way, it is relieved of most of the weight upon it; for it very evidently results from the experiments cited, that whatever may be the weights of the different parts of a wall resting upon a bed of sand suitabl ydisposed, or whatever may be the differences of resistance of the bed of the foundation, no part of this bed can yield without the pressure upon it decreasing or the neighboring parts giving way at the same time and the settlement becoming uniform in consequence."

The only difference in the results of these two series of experiments is that, in the first, the resulting pressure after a part of the bottom had commenced to yield, became constant, whatever the surcharge; while in the second, they were proportional to this surcharge.

The details of the operations of the first series are not given, so it is impossible to discover the cause of the discrepancy. If the weights upon the sand had rested upon a platform larger than the aperture in the bottom, or if the weights themselves had been of such size as to rest upon the parts of the sand less susceptible to yielding, the results would agree with those of the nineteenth experiment above.

The Lateral Pressure of Sand.

20. To investigate this, a box 0.7 m. long, 0.6 m. wide and 0.7 m. high (2¼′ × 2′ × 2¼′), filled with sand, was used, one of the sides of which, 0.6 m. in width, was composed of two pieces *a b* and *c d* (Fig. 7), each 0.35 (13¾″) in height, arranged to slide up and down in the guides *c d*; thus enabling them to expose any part of the side *e f*. When the distance between *a* and *c* was less than 0.2 m. (7⅞″), the sand sustained itself alone; continuing to enlarge the opening *a c*, a prism *a g h k* was detached; when this distance became greater than 0.35 m. (13¾″) the sand ran out down to the slope *a l*.

The result was the same for all points of the side *e f*, provided a height of at least 0.1 m. (4″) of sand was maintained above *c*.

When the side was slipped down and the upper cross-piece was removed, so as to leave the top layers unsupported, the sand held itself for a height of 0.2 m.; when the side was lowered further, the sand ran out. The same results were obtained when a load was placed on the sand of 200 and 400 kilograms (441 and 882 lbs.).

It appears from the above that the sand comports itself as regards the pressure upon the sides, as upon the bottom; if a limited portion of the side wall yields, the sand buttresses itself against the more resisting parts; beyond a certain limit cohesion and friction are unable to retain it, and it runs out.

The explanation already given of the formation of arches by the sand, is confirmed by the disposition of the latter when the prism *aghk* is detached. In both cases the grains which the upper layers are unable to retain against the fixed points, are the first to give way to the action of the weight. The angle of repose of the sand used in the second series varied with the humidity of the sand and the load supported upon it, but in no case was it less than forty-five degrees. When the sand was wet it would hold itself at steeper angles. The pressure brought upon it during the experiments produced very evident effects, it often standing on a slope of three vertical to one horizontal, or at an angle of 71⅓ degrees; a slight effort, however, being sufficient to change this slope. In loading a mass of the unsupported sand of which the slope was forty-five degrees, with considerable weight, the pyramid settled down, the slopes moving back parallel to themselves, preserving nearly their original inclination; so it appears that this should be considered the natural inclination of the sand used in the experiments.

The pressure of the sand upon the vertical sides which confine it may be calculated by the usual formulæ for earth pressure; but in order to find what would be the necessary increase in width of a footing course composed of a mass of sand and loaded with a certain weight, in order to overcome the lateral pressure by the weight of this increased footing, the following experiment was made:

21. A bottomless box (Fig. 8) 3⅓ m. long, 2 m. wide and 1 m. deep (11⅛′ × 6⅝′ × 3¼′) was placed upon level ground, filled with sand and near one end a mass of pig-iron was piled up, weighing 15,000 kilograms (33069 lbs.) and resting upon a platform of joists 1.9 m. long and 0.8 m. wide (6¼′ × 2¾′); the load being 9,868 kilograms per square metre (2026 lbs. per sq. ft.).

During the loading the platform sank 0.003 m. (⅛″). The next day there having been no further movement and no displacement of the sand at the sides of the platform, the end of the box opposite to that near which the iron was stacked was removed, upon which the sand slipped down to its natural slope of nearly forty-five degrees, without disturbing at all the superstructure.

When little by little, the sand was removed from the toe of the slope, the latter reproduced itself by the sliding of the material from above, until the point *a* was reached, the top of the slope *g* being then 1.05 m. (3′ 5¾″) distant from the foot of the load; when the pile leaned to one side and fell.

It was, then, near this point that the pressures first became sensible, and if the side of the box had been moved to the point *a* it would have resisted only the thrust of the prism *bac*.

In order to find the resistance which the prism *adeg* opposes to the lateral pressure we can suppose a vertical wall at *ed*. Calculating the pressure upon this, from the weight of the superstructure and sand, and dividing it into the weight of the prism of sand *adeg*, the result would be the ratio between the two forces, necessary for equilibrium.

There would be too many variables in the problem, however, to give the ratio any significance beyond this one case; further experimentation might establish some constant relations which would be of value, but it is doubtful.

The description of these experiments will be completed with a reference to two, made at Bayonne, to show the comparative advantage of the use of sand for a given soil. They were performed on the edge of the ditch of the fort, where it was proposed to build a stone scarp, and where a sounding rod thrust down 20 m. (65′) indicated only miry sand. This material was mud in the first place and the water standing in the ditch to within a metre of the tops of the experimental pits, kept it constantly wet.

22. A pit 2.84 m. (9.32′) deep and 1.2 m. (3.94′) square was excavated, and filled with sand for a height of 1.2 m. upon this was a platform of oak, 0.05 m. (2″) thick, and 1.2 m. square. The sides of the excavation having fallen in slightly, the platform did not completely cover the sand. Having carefully leveled this platform it was loaded with 29,000 kilograms (63,934 pounds) equivalent to 4,126 pounds per square foot, causing a settlement of 0.065 m. This load remained for fourteen days, the settlement being taken every two days as follows:

		Metres.
During loading,	settlement	0.0650
2nd day	"	0.0500
4th "	"	0.0050
6th "	"	0.0025
8th "	"	0.0025
10th "	"	0.0003
12th "	"	0.0003
14th "	"	0.0003
	m.	0.1259 =5″.

During the first three days the load, which was 3.2 m. (10⅝′) high, leaned slightly, but it was then retained in this position without material change. When the load was removed at the end of the fourteen days, the platform had scarcely been forced into the sand at all.

23. Three metres distant from the first, a second pit was excavated, similar to the former, except that it had 0.33 m. less depth, thus bringing its bottom to about the middle of the mass of sand in the first. In this they put no sand, a platform similar to the other one being placed directly upon the natural earth and loaded as before; during which the settlement was 0.27 m. (10⅝″). The load leaned so much to one side from unequal settlement that it was necessary to move a great part of it to the opposite side, where it remained. Below are the settlements observed:

		Metres.
During loading,	Settlement	0.2700
2nd day	"	0.0900
4th "	"	0.0200
6th "	"	0.0100
8th "	"	0.0075
10th "	"	0.0075
12th "	"	0.0000
14th "	"	0.0000
	m.	0.3500 = 13¾″

Comparing the two experiments, the settlement in the first is seen to be only about one-third of that of the second; most of the difference being during the time of loading. The advantage in the use of the sand is apparent also regarding the liability to overturning; if the sand had been given a larger footing than the load, the slight leaning would have been prevented, as by that means the pressure upon the vertical sides of the excavation could have been decreased sufficiently to prevent any lateral compression of the soil.

Applications.

Sand has been used for a long time in Surinam for the founding of all the largest edifices and in the worst soils, but there are no published records, to our knowledge, in regard to the details of its application.

In France its use has been more common, although here also the published instances are not very numerous. A few instances of its application in very bad localities will be given here.

For the foundations of the pillars of a portico in front of a guard room at Monsseroilles, the earth was first taken out to a depth of 3 feet 4 inches below the footing course, or about 5 feet 4 inches below the surface of the ground, and to a width of 3 feet 6 inches at the bottom and 4 feet 6 inches just below the footing. This space was then filled in with sand, well beaten with rammers: on the sand two courses of rough masonry in common mortar were laid, the lower one being 3 feet 4 inches square, the upper set back 4 inches: upon these the pillar was built. Before completing the work one pillar was loaded with 20,000 pounds of lead, without any sensible settlement. When the work was finished each column was estimated to carry about 22,000 pounds or about 2,000 pounds per square foot. Two years later, this porch showed no signs of settlement, although the guard house wall, built upon its old foundations had not ceased to sink. The soil is alluvial, being mud extending to a great depth.

The arsenal at Bayonne, is built upon alluvial silt of great depth, upon which a building had been erected a few years earlier, founded without piling, which had cracked so badly as to necessitate its removal. After making the experiments previously given (numbers 7 to 11) upon the site, it was decided to use sand piles for the foundations of the blacksmith shop, wood piles not being admissable on account of the variation in the height of the ground water. This building consisted of pilasters joined by a wall about breast high; the weight of one of the pilasters with the roof it supports is 75,600 pounds; 2200 pounds was taken as the limit of the weight to be supported by each pile. The ground under each pilaster was consolidated by driving small piles about 7 inches diameter and 6 feet long; then withdrawing these and putting sand in the holes. As an additional precaution however, small piles 3 feet in length were driven until their heads were on a level with the bottom of the sand piles. The surface of the ground was then leveled, the spaces between the sand piles paved with small stones well rammed.

The foundations of the connecting walls were prepared in a similar manner, except that the extra wood piles were not used. From what we have learned of the lateral pressure of sand, it is probable these wood piles were of no service whatever.

In Paris a sewer which had been built for four or five years, sank suddenly for several metres of length, and it became necessary to rebuild it. When the damaged portion was taken out it was discovered that the foundation had been laid upon a mass of made soil of 9 feet thickness, a portion of which was a scavenger's deposit.

The new foundations could have been made secure by going down to the natural ground, but this would have been too expensive; instead, 5 feet of the made ground was left in place, and was consolidated by sand piles impregnated with about ½ of their weight of milk of hydraulic lime. This last was used as the ground was traversed with many springs. The holes were made with a slightly conical pile 6 feet long, and the piling was continued until the intervening ground commenced to swell up. Upon this a bed of béton was placed and the sewer upon it. Two years later there had been no settlement.

A ferryhouse on one of the Parisian canals was built upon a soil of peat, an exceedingly bad foundation from its great compressibility. Desirous of making the construction at once cheap and yet very strong, the earth over the entire site was taken out for 6 feet below the footing course, and replaced with sand. The building was erected upon this as upon natural ground; with no subsequent settlement of the masonry.

Sand was used very extensively for making foundations for the canal St. Martin, Paris; for the quay wall of the Gare, 100 metres long and seven metres high, a bed of sand 1.2 m. (3.94′) deep was placed in a mass of compact and impermeable clay, for a footing.

Other examples might be cited, but it is believed the above are sufficient to indicate the manner of application.

Conclusions.

The opportunities for the use of sand are numerous, and it is believed a more general employment of it, would result in greater economy and stability of construction than is the case at present. It differs from concrete as regards the distribution of pressure, in that it acts as an arch across weak spots in the foundation rather than a beam, and in the lateral pressure exerted upon the sides. In proportioning the size to be given such a footing, it seems advisable to have recourse to the formulæ for pressure of earth against walls, allowing such dimensions as to reduce the pressure upon the sides and bottom to such amounts as may seem desirable for special locations.

In soils of so little consistency as to prevent the opening of the trenches necessary for the introduction of a mass of sand, and in which it would be difficult to prevent the admixture of mud, the method of sand-

piles would be advisable, and would frequently offer greater advantages than those of wood, even with respect to solidity. The great objections to the use of the latter are their liability to considerable settlement unless their feet rest upon the underlying rock, or some similar hard material, and their certainty of rotting unless continually surrounded with water.

Sand-piles apparently have neither of these defects: incapable of yielding at the foot, any tendency to bend laterally increases the compression upon the surrounding earth.

The sand used should be moderately fine, angular grained, clean and uniform in size, to secure the least settlement and the best results. If wet, it should be rammed in thin layers, with considerable force, especially near the sides, in order to have it well supported and conform to the irregularities of the sides. If dry, it arranges itself better in the excavation, but it will be necessary to wet it when in place and ram it.

As to the comparative cost of sand and wood piles, it is believed the varying circumstances will have such a controlling influence in each case, as to prevent any generalization being of service, and as all our data of that nature is foreign in its origin, it is omitted.

Municipal Engineering; Paper No. 2.*

PROVIDENCE, RHODE ISLAND.

(*Continued from Page 337*).

In addition to the department indexes, a general alphabetical index is kept in the business office, in which the drawer location of all first and second class plans are entered.

January 1, 1886, the day book showed 011,561 plans to date, and the number of indexed office plans on the same date was 8,660.

Records.—The records of the different departments are kept by the department to which they relate. Each engineer keeps account of the time, and class of work engaged upon, and monthly makes return of the same to the assistant engineer in charge of the department in which he is employed. The assistant engineer returns a summary of the time of his men to the City Engineer and the division of the pay roll is made up from the returns.† The engineers are paid at annual rates.

Blank A.

CITY ENGINEER'S OFFICE.

Report of Time of —— for the month ending ——188

DATE.							Horse Car Tickets.	
							Expend.	Recd.
4th St.								

†Accompanying blanks (A. B.) is the form used for monthly division of time.

Blank B.

CITY ENGINEER'S OFFICE.

Division of time of —— for the month ending —— 188

Names.	Classes of Work.							Total Salaries.	Horse Car Tickets.	
									Expended.	Received.
Totals,										

The state of the appropriations, the account of all bills contracted and approved by the City Engineer, both as City Engineer and Superintendent of Water-Works, Highways, Sewers and Bridges, and copies of estimates, communications and reports are recorded in the business office.

The notices of parties intending to build or to make alterations to buildings are taken in the business office, and a copy of said notice sent to the Inspector of Buildings. Accompanying blank (C) is the form used. When the applicant requests the street line or grade defined in front of his estate, the City Engineer, within three days' marks the same on the street, providing that the street lines are legally defined, or if a grade has been legally established. In case the line cannot be accurately marked and the grade is not established, approximate lines and proposed grades are given by the courtesy of the City Engineer, provided the applicant exempts the city from damage in case said line or grade as he may mark should not become legally established. Accompanying blank (D) is the form used in this case.

Blank "D."

PROVIDENCE, R. I., January 4, 1886.

I hereby acknowledge that Samuel M. Gray, City Engineer, has this fourth day of January, A. D., 1886, stated to me that he cannot give the line of King street in the time that I wish the same, yet with this knowledge I hereby request him to give me said line approximately, agreeing to hold the City of Providence exempt from any liability in case it proves that said line as he may give it is not the exact line.

I hereby acknowledge that I have been informed that the grade of King Street is not legally established, but I would request that the grade of said street be given as proposed July 30, 1885, agreeing to hold the City of Providence exempt from any liability in case said grade, as given, shall not become the legally established grade.

[Signed] JOHN N. SMITH.

(TO BE CONTINUED.)

Chicago, Milwaukee & St. Paul R. R.—Two thousand men are at work on the Kansas City extension. The officials state that the line will be completed to Chillicothe, Mo., by January 1st, and to Kansas City by June 1, 1887.

LITERATURE.

Publications Received.

The New Agriculture, or The Waters led Captive, by A. N. COLE. Wellsville, N. Y. The Angler's Publishing Co., N. Y., 1885. Price $2.00.

Annual Reports of the Harbor Commissioners of Montreal for the year 1885. Harbor Commissioners of Montreal, 1886.

Transactions of the Technical Society of the Pacific Coast for March and April, 1886.

CONTENTS: *Compound Transition Curves*, by W. G. RAYMOND; with Minutes of Meetings of March 5th and April 3rd. Edited by the Secretary. San Francisco, Cal., 1886.

Transactions of the American Society of Civil Engineers for March, 1886. Edited by the Secretary.

CONTENTS: *The Abt System of Railway for Steep Inclines*, by WALTON W. EVANS, Member of the Society: *Early Surveys and Report in Reference to the Transmission of Trade across the Alleghany Portage*, by MONCURE ROBINSON. Minutes of Meeting of March 3rd and 17th. Memoirs of deceased Members: JOHN GRIFFIN and REDMOND JOHN BROUGH. List of Members, Changes, Corrections, etc.

The Cornwall Iron Ore Mines, Lebanon Co., Penna, by EDWARD V. d'INVILLIERS, Geologist and Mining Engineer, Philadelphia, Pa. From the Transactions of the Am. Inst. Mining Engineers, Pittsburgh Meeting, Feb., 1886.

Seventh Annual Report of the Bureau of Labor Statistics of the State of Missouri, for the year ending December 31, 1885. Jefferson City, Mo., 1886. From OSCAR KOCHTITZKY, Commissioner.

Blank C.

Asst. Eng. Slip.

No. 113. *January* 1, 1886.

JOHN N. SMITH intends to build west side King street, south of Sixteenth street, and requests line soon.

January 4, 1886.

King street is not rec'd; can be given approximately.

No. 113. *January* 1, 1886

JOHN N. SMITH intends to build west side King street, south of Sixteenth street, and requests grade soon.

Grade of King street is not established; can be given approximately.

ADDRESS OF BUILDER,

JOHN N. SMITH,
12 King Street.

LINE.

King street is not received; can be given approximately.
" " " " "

GRADE.

King street is not established: can be given approximately.
" " " " "

No. 113. CITY ENGINEER'S OFFICE.

PROVIDENCE, *January* 1, 1886.

To the INSPECTOR OF BUILDINGS:

Sir: Notice has this day been given by JOHN N. SMITH, 12 King street, of intention to build a two and a-half story wood, about thirty-five feet high, building, to be located in the Second fire District, on west side King street, south of Sixteenth street, on estate owned by John N. Smith. It is represented that said building is intended for two tenement dwellings, and is to be built by White & Co. Estimated cost $4,000.

City Engineer.

No. 113. CITY ENGINEER'S OFFICE.

PROVIDENCE, *January* 1, 1886.

To the CITY ENGINEER:

Sir: The undersigned hereby gives notice of intention to build a two and a-half story wood, about thirty-five feet high, building, to be located on west side of King street, south of Sixteenth street, on estate owned by John N. Smith; said building is to be used for two tenement dwellings, and is to be built by White & Co. Estimated cost, $4,000; and I hereby request that the line and grade of said street for said building be defined accurately if they can be; if they cannot be accurately, to be approximately defined.

JOHN N. SMITH.

The 32nd Annual Report of the Board of Water Commissioners of Hartford, Conn., for the year ending March 1, 1886.

The 13th Annual Report of the Lowell, Mass., Water Board for 1885.

The 13th Annual Report of the Water Commissioners of New Brunswick, N. J., for year ending Dec. 31, 1885.

Statistical Statement of WM. S. JACKSON, Receiver of the Denver & Rio Grande Railway, from July 12th, 1884, to December 31, 1885.

The 13th Annual Report of the Trustees of Water Works, Toledo, Ohio, for the year ending December, 1885.

Annual Reports on the Water Works of Worcester, Mass., for the year ending November 30th, 1885.

Report of the First Annual Meeting of the Illinois Society of Engineers and Surveyors, held at Champaign, Ill., Feb. 10, 11, and 12, 1886. PROF. A. N. TALBOT, Champaign, Ill., Executive Secretary. Price 35 cents.

The 16th Annual Report of the Trustees of the Columbus, Ohio, Water Works for the year ending March 31, 1886.

Annual Report of the Board of Public Works and City Engineer of Milwaukee, Wis. for 1885.

Proceedings of the U. S. Naval Institute. Published Quarterly at Annapolis, Md.

The Magazine of Art for June, 1886. CASSELL and COMPANY, New York. Price 35 cents per number, $3.50 per year.

Cassell's Family Magazine for April and May, 1886. CASSELL and COMPANY, New York. Price $1.50 per year

*Copyrighted by ENGINEERING NEWS PUBLISHING Co., 1886.

Annual Report of the Norfolk & Western R. R. Co., for the year 1885.

Report of the City Engineer on the River Improvements and Sewerage of San Jose, California, April 1, 1886. J. H. PIEPER, City Engineer.

Guide to Buyers and Sellers of Real Estate. How to Draw a Contract. BY GEO. W. VAN SIECLEN, Counsellor-at-Law. Price 50 cents. Paper covers. $1.00 cloth. Published by Real Estate Record and Builders' Guide, 191 Broadway, New York.

Annual Report of the Philadelphia Co., (Natural Gas) *for 1885-6 together with Records and Documents relating to the Incorporation and Organization.* May 24, 1884. Also the Philadelphia Company's *Yellow Book on Natural Gas.* Pittsburg, 1886.

From the Institution of Civil Engineers, London, Eng. *"Railway Rolling Stock in Italy"* by S. Fadda. *"Oil Wells of Baku,"* by F. Vasiieff, M. E.; *"Experiments on the Measurement of Water over Weirs,"* by Bryan Donkin and Frank Salter. This last paper we will reprint.

On Gas-Producers. By FREDERICK JOHN ROWAN.

Abstracts of Papers in Foreign Transactions and Periodicals. Excerpt Minutes of Proceedings of the Institution of Civil Engineers. Vol. LXXXIV. Edited by Jas. Forrest, Secretary.

An Address "Upon Engineering Matters," by PROF. J. A. L. WADDELL, C. E., before the Members of Kogakukyokai, Tokio, Japan, February, 1886.

American vs. English Methods of Bridge Designing. Reprinted from the *Japan Mail.* A controversy between PROF. J. A. L. WADDELL and others. A pamphlet of 64 pages, price 50 cents, to be had by addressing Prof Waddell, care of Horace Everett, Esq., Council Bluffs, Iowa, after June 1st, or at this office.

Proceedings of the Association Provincial Land Surveyors of Ontario, at its first Annual Meeting in Toronto, Feb. 23, 24 and 25, 1886.

CONTENTS: List of officers, constitution, etc. and the following papers: "The Surveyors' Act" "Land Drainage" "Management of Township Roads" "Surveyors Instruments," "Quirks," "Biographical Sketch of Reuben Sherwood." The pamphlet is a neat octavo of 68 pages and in its general make up shows that our Canadian brethren are superior in some points to their Yankee cousins. Two neat and suggestive illustrations help to make the pamphlet an attractive one. Willis Chipman, village engineer, Brockville, Ont., is the Secretary and copies can be had by addressing him. No price given.

Transactions of the New England Water Works Association for the year 1885. ALBERT S. GLOVER, Secretary, Newton, Mass.

Papers and discussions on the following subjects are published: "Water Waste in its Different Phases," by Peter Milne, Jr. "Rules and Regulations," by C. H. Brown. "Self Closing Plumbing Work," by W. C. Stripe. "Steam Boilers and their Settings," by P. H. Lineen. "Reports on Pumping Engines," "Kalamein Pipe," and "Tests of Coal;" "What is Perfect Duty?" by Wm. Golden. "Cast-Iron Pipe," by A. H. Howland; "Difficulties Encountered with Plumbers," by W. L. Cameron. "Street Mains," by G. A. Ellis. "Reports on Railroad Water Supply;" "Annual Reports," and "Rules Governing Duty Tests." Three large folding sheets showing "Statistics of the Weights of Cast-Iron Pipes in Practical use, and the Theoretical Height Deduced from various formulæ," by A. F. Noyes are included in the bound volume, and cannot fail to prove of great interest to water-works engineers. Uniformity of Water-Works Reports has been a subject of much discussion, and the Report of the Committee on Reports gives a Sample Report which should be studied by all Superintendents of Water-Works. The volume is bound in boards, and contains 240 pages of matter invaluable to Superintendents and Engineers of Water-Works. Address the Secretary.

Incidental reference to German adoption exclusively of metric nomenclature. A matter fully treated in report of Committee on Weights and Measures to Boston Society of Civil Engineers, in May number of Journal of Association.

Readers of the Article on *The Metric System in Germany*, published in ENGINEERING NEWS of May 30, 1885, may have been puzzled by the denial in the *Centralblatt* that there was in Germany a metric nomenclature based on old German names of weights and measures, when the *Moniteur Industriel* cited an express provision of such a nomenclature in the law by which Germany adopted the metric system. The apparent contradiction may be explained by the fact that these German names were forbidden and the exclusive use of the appropriate metric nomenclature was required by a supplementary law, promulgated July 1, 1884, which foreigners did not generally know until a little later, as it attracted but little public attention.

The Indian Engineer, Calcutta, April 17th, 1886. Vol 1, No. 2. Published fortnightly by J. W. NEWMAN & Co. Calcutta, India.

This is the latest candidate for the patronage of the engineering world, and is a very creditable journal in both "make up" and contents. In this number appears two double page illustrations of the Burdwan Water-Works, with very full descriptive text. An article on the Calcutta Water-Works is concluded, and there is a very considerable variety of articles specially interesting to Indian engineers, but also of interest generally to others of the profession. American advertisers are well represented in its pages. It is a thirty-two page paper (same size page as ENGINEERING NEWS,) of which twenty are devoted to literary matter. The price is twenty rupees per annum. We wish its projectors abundant reward for their enterprise.

Yoketano Taisukyo tuketari iroirono Dyosu oyobi Kosiki. Tanakadate Aikitu Hensansu; or, *Four Place Logarithms with various Constants and Formulæ*, compiled by AIKITU TANAKADATE.

This little work of fifteen pages, although simply a book of useful tables and formulæ judiciously compiled, is one of unusual interest not only to the Japanese but also to all those who take an interest in the welfare of that progressive nation. It is the first book published in *Romaji* or Roman characters in Japan. Its author holds the position of Assistant Professor of Physics in the Imperial University (formerly University of Tokyo). He is very generally recognized as one of the most progressive and original of the educated Japanese, and is deserving of great credit for having at the expense of much thought, labor and money showing the applicability of the *Romaji* to useful and scientific purposes.

The "Romaji-kai" or, "Society for the Adoption of Roman Letters," was organized some eighteen months ago principally by professors in the University of Tokyo, and in this, the greatest undertaking of modern Japan, Mr. Tanakadate took a prominent part. The object of this society met with such universal approval that at the end of the first twelve months of its existence it numbered over 6,000 members all belonging to the educated classes, and many of them leading men both politically and socially. The Japanese nation has entered into this undertaking with such energy and enthusiasm that the success of the society is assured. The one essential step left to be taken is to obtain the sanction of the Minister of Education to the introduction of the teaching of *Romaji* in the common schools, and it is more than probable that his consent will soon be given.

Mr. Tanakadate's book contains four-place logarithms of numbers from 1 to 1,009 with proportional parts of differences, log sines, cosines, tangents and cotangents, anti-logarithms of numbers to four places of figures with proportional parts, anti-logarithms of sines, cosines, etc., natural sines, cosines, etc., squares, square-roots, reciprocals, ratios of different units of length, capacity and mass with their logarithms in red ink, dimensions of the earth, magnetic declination for Tokyo, trigonometrical and integral formulæ and much other useful information which it would take too much space to mention in detail.

We congratulate Mr. Tanakadate on the energy which he has displayed, and predict for his book the most gratifying success.

We want to buy the Title page and Index for ENGINEERING NEWS, *January to July, 1884, and will pay twenty-five cents for it.*

Ohio Railroad Report.

Annual Report of the Commissioner of Railroads and Telegraphs of Ohio, for the year ending June 30, 1884, by HON. H. SABINE, Commissioner, Columbus.

This report is just out, being nearly two years after the close of the time covered. The delay seems to have been caused by the exhaustion of the general appropriation for printing. The report is a fat octavo of 1,200 pages of statistics, together with an appendix of 200 pages of special reports. The report shows 9,045 miles of track in the State, 278 miles of double track, and 1,713 miles of sidings. The stock and debts amount to $72,384 per mile. The cost of road and equipment is reported to be $73,998 per mile. The passenger business increased 2.36 per cent.; the rate per mile was 2.281 cents, a decrease of 6 per cent. The tonnage increased 7.3 per cent.; the rate per ton mile was 0.789 cents, a decrease of 9.8 per cent. The report claims the rate per ton mile is the lowest in the world. The present rate is less than one-third of that in 1871. The net earnings were 3 per cent. on capital stock and debt, a decrease of 13 per cent. The total operating expenses were 71 per cent. of the gross earnings, the maintenance of way and structures 20 per cent.; cars 8 per cent.; motive power 22 per cent.; transportation 40 per cent.; the number of employés averaged nearly five per mile. 53 per cent. of the track in the State is ballasted. There is nearly ninety-six miles of bridges and trestles, or about 70 feet per mile of road; there are sixty-two miles of wooden trestle, seventeen miles of wooden bridges, twelve miles of iron bridges, three of combination, two of stone arches. The damages for stock injured amounts to $1.00 per 800 train miles; the year before the last it was $1.00 per 510 miles, and in 1880 it was $1.00 for 3,000 miles. A passenger was injured for each one carried 25,000,000, and a passenger was killed for each 162,000,000 miles travelled. An employé was injured for each 200,000 train miles, and one killed for each 800,000 train miles, 344 persons were killed, and 515 others were injured. Each road in the State was inspected during the year, the details of any changes or improvements made during the year being noted in the report. The various statistics will be useful to railroad engineers for reference and comparison.

The appendix consists of special reports. These reports were prepared by the inspectors who had inspected the roads for the preceeding four years. Prof. R. W. McFarland discusses the permanent way through fifty pages, under the sub-heads methods of construction of permanent way, masonry, piers and pier foundations, drainage, means of diverting injurious water courses and land slides. Although the report seem to be quite different, owing to a lack of funds for engraving and printing, than as first planned, it is very valuable.

Prof. S. W. Robinson, M. Am. Soc. C. E., devotes 133 pages to vibrations in bridges, permissible working stresses in bridge members, strength of columns, brakes, couplers, railroad testing laboratories, and curves and sidings. Some very interesting diagrams are given, showing the lateral and vertical vibrations of bridges under a passing train. The first is a discussion of the cumulative effect of a unison between the time of vibration of a bridge and the blows due to the counter balancing weights in the driving wheels of the locomotives. Concerning the second topic, we will have something to say before many weeks. The third item consists of a re-discussion of Robinson's Rational Column Formula; there seems to be nothing in it which has not already been in print. The report on brakes seems to be a scientific and exhaustive comparison of the relative merits of the various devices for stopping railway trains. Under the head couplers are announced the supposed conditions which the coming perfect coupler must satisfy, Lieut. Ruhlen, U. S. A., prepared an extensive report on terminal facilities which was not published owing to the expense of printing the necessary illustrations. It is to be regretted that the great State of Ohio should have been so foolish as to be at the great expense of having much valuable matter collected and prepared and then refuse to make it available for the sake of saving a few dollars for the printing. From the very nature of the case such material can be collected only by authority of a state or the general government, and the publications of such matter would be of value to the railroad interests and, therefore, to the whole state and country. The experience gained during four years of detailed inspection of railroads and the facilities which they enjoyed for collecting information, would have enabled them to make a report of very great value; as it is, the volume before us is valuable, but a little money for illustrations would have made it very much more so.

Prof. T. C. Mendenhall gives a short account of the railway electrical appliances exhibited at the Philadelphia Electrical Exposition. Chas. Latimer, Chief Engineer, N. Y. P. & O. R. R., gives a paper on Railway Organization, which will be read with interest by railway managers, both present and prospective.

This report will doubtless be in as great demand as was that for 1881. We do not know what the regulations are concerning the distribution, but we can only repeat what has been said many times before concerning public documents which are certain to be in demand, that it is a great pity that such reports do not more largely reach the hands of those to whom they are especially valuable. If the present method of distribution by legislators, aldermen, etc., is to be persisted in, then a larger edition should be published and the additional copies should be placed on sale at cost. We are greatly surprised that this method was not pursued in this case, and possibly the price of the volumes placed on sale could have been made to cover the cost of the portion that has been omitted.

The Little Falls, Mille Lacs & Lake Superior Railway Company has been incorporated to build one or more lines of standard or narrow gauge railroad from the village of Little Falls past the south end of Mille Lacs to a point on the eastern boundary of the state, and one or more branch lines from some point or points on the main line to the northern and also the southern boundaries of the state. Capital stock $2,000,000. The incorporators are: J. C. Flynn, Peter D Blake, Little Falls, Wis., Charles Gravel, Frank X. Gault, Graceville, and John Stumph, Rich Prairie.

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.
TRIBUNE BUILDING, - NEW YORK CITY.

THE ENGINEERING NEWS PUBLISHING CO. PROPRIETOR.

VOL. XV. Saturday, May 29, 1886.

CONDUCTED BY
GEO. H. FROST, - - - Assoc. Am. Soc. C. E.
D. McN. STAUFFER M.Am.Soc.C.E.: M.Inst.C.E.

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A meeting of the American Society of Civil Engineers will be held on Wednesday, June 2nd, at twenty o'clock when a paper on "Constants of Steel," by Prof. Palmer C. Ricketts, Assoc. Am. Soc. C. E., will be read and discussed.

HON. ROSWELL P. FLOWER on the 25th, was appointed to the vacancy upon the Board of Subway Commissions occasioned by the death of the late Mr. Charles E. Loew. This board of eminent electricians are now Jacob Hess, Theodore Moss and R. P. Flower, and what they do not know about laying wires underground, or elsewhere, is not worth knowing.

A NEW office, to be known as the Commissionership of Public Works and Health, was created by the City Council of Toronto, Canada, on the 16th. Applications for the position are now in order. A thoroughly competent engineer of the highest professional standing is wanted. He shall act as Consulting Engineer, and direct and supervise all public works of the city. The present officers shall act as his assistants in carrying on these works. The salary attached to the office shall not exceed $6,000 per annum.

THE announcement of the Denver Convention of the American Society of Civil Engineers states that the time of leaving Grand Central Depot, New York is 10 A. M., June 29th. The route is over the Chicago, Burlington & Quincy R. R. west of Chicago. The estimated expense is about $60 for the round trip from New York to Denver and return, depending somewhat on the number going, and this includes transportation and one berth in a sleeper. A remittance of $20 must accompany the order for accommodations. Early application is very essential to the success of the excursion, so that the Secretary may be able to provide all necessary accommodation.

SENATOR HAWLEY, from the Com. on Coast Defenses, reported, May 18, favorably the two bills introduced early in the session by Senator Cameron authorizing the Secretaries of War and Navy respectively to make contracts after suitable advertisement with responsible steel manufacturers for the supply of rough bored, rough turned and tempered steel for the fabrication of heavy ordnance adapted to modern warfare, and steel for armor, shafting and other army and naval purposes, in quantity not to exceed 10,000 gross tons for each department. To each of the bills the committee have added a section appropriating $8,000,000 to be available during the six years from January, 1887.

Bradstreets summary of the labor strikes strikes to May 21 is as follows:

Total on strike May 20th was 47,625

The building industry has sustained indirectly the severest blow of any due the unwillingness of contractors to take contracts for fear of estimates of cost being disturbed by renewed labor troubles. The losses sustained through deferred or canceled building contracts have been more thoroughly reported than those in any other line at the cities where strikes have been most general. The resultant total of loss is $20,400 000 at ten cities—Philadelphia and vicinity losing $5,000,000. Details from strikes since May 1 at the industrial centres reported have been:

	Wages.	Current Business.	New Business Stopped.
New York City	$500,000	$300 000	$2,000,000
Philadelphia	60 000	50,000	5,000,000
Smaller Pa. cities	70.000	50,000	.....
Detroit, Mich	97 000	25,000	850 000
Cincinnati	375,000	300,000	1,000,000
Milwaukee	465,000	200,000	4,000,000
New England cities	275,000	.....	6,000,000
St. Louis	75,000	.....	.....
Troy, N. Y	75,000	.....	150,000
Washington, D. C	$4,000	.....	2,000,000
Indianapolis	2,000	.....	.....
Pittsburg	30,000	75,000	3,000,000
Louisville, Ky	23,000	5 000	500.000
Coal strikes	200,000	500 000	Interm'e.
Chicago	700,000	700,000	3,000,000
Totals	$2,802,000	$2,105,000	$24,800,000

The following are the Naval appropriations under the different heads as contained in the present bill;

Pay of Navy	$6,553,207.26
Navigation Bureau	12 500 00
Ordnance	224.60 .00
Equipment and Recruiting	851,8 0.00
Yards and Docks	314,000 00
Naval Asylum	74,257.00
Medicine and Surgery	110 000.00
Provision and Clothing	913 585.24
Construction and Repair	1,023,000.00
Steam Engineering	808.167.25
Naval Academy	164,503.00
Marine Corps	642,288.50

FROM *Herapath's Railway Journal* we note that "the survey for the railway from Mandalay to Province of Burmah, India, to Tounghoo has been commenced. Mr. Robert Gordon, an engineer well known in the province, has been selected by the Government for the work, and has left for Kyouksai."

Mr. Robert Gordon, formerly Chief Engineer of Public Works for the Province of Burmah was a guest of the American Society of Civil Engineers at the Buffalo Convention in 1884, and will be very pleasantly remembered by numerous acquaintances made at that time. Mr. Gordon was most favorably impressed with American methods in railway building as adapted to new countries, and with American machinery he was so well pleased that he has through these columns asked for catalogues, etc., for reference. On March 16th last, a paper by Mr. Gordon was read at the meeting of the Institution of Civil Engineers, "On the Economical Construction and Operation of Railways in countries, where small returns are expected, as exemplified by American Practice," which was reprinted, in abstract, in this journal (page 241 *ante*), and in which the results of the studies of American railway practice by the author, are given very fully.

ENGLISHMEN propose to have a railroad system of their own in this country. The Canadian Pacific is out of the way for rich local traffic. Chicago direct to Liverpool is the desirable thing. Mr. James Black, of London, England, is on a reconnoitering tour of this country in the interest of an English syndicate who propose to build another "short line" railway from Chicago to New York with "branches" from Cincinnati to New York and from Chicago and Cincinnati to Baltimore. Charter already secured. It is to be called the Midland Railway. Capital $100,000,000. A line of steamers to run in connection from Baltimore to Liverpool, there connecting with the London and Northwestern, in the service of which company Mr. Black now is. Capital all pledged. Such is the "yarn" reeled off from Chicago on the 23d. We hope Mr. Black's scheme will be heard from again. Bring on your surplus cash, Mr. Black!

Guns.

The *Army and Navy Journal* says of our cast-iron Rodman guns "we believe but one has ever burst in service, and that was the result of the jamming of a shell," and adds that Mr. Hunt of the South Boston Iron Works, holding that the strength of heavy steel forgings is greatly over-estimated as the strength of our gun iron is under-estimated, has offered to furnish to Government for testing, cast-iron Rodman guns free of cost, on condition that should guns of the same weight and dimensions as the modern steel guns, stand the strains which modern powder gives, Government should give an order for similar guns at half the cost of steel guns. This offer of Mr. Hunt looks like a reasonable one, and is apparently worth testing.

Our gun iron is a very superior metal; possibly the best was put in some thirty or more guns ordered from I. G. Johnson, of Spuyten Duyvil, by the State of New York. Mr. C. C. Martin, now of the Brooklyn Bridge, who tested peices from the sinking heads, told us that the test prices averaged a tensile strength of 42,000 pounds per square inch. Some of these guns are now around the State Arsenal at the corner of Seventh avenue and Thirty-fifth street and could doubtless be secured for a test against steel guns of equal weight.

In the meantime the new English steel breech-loaders do not seem to be satisfactory, one of the 43-ton 12-inch guns having had its muzzle blown off by a reduced charge of 221 pounds of powder and a shell filled with water and weighing 714 pounds, the difficulty with the gun apparently being that it was not well proportioned for the modern slow burning powder.

The Ventilation of the New Croton Aqueduct.

The complaints against the sanitary conditions of the New Aqueduct in general, and of its ventilation in particular, induced a resolution in the State Senate directing the State Board of Health to investigate the subject. The report and appendices signed by Lewis Balch, M. D., Secretary, and James T. Gardener, Consulting Engineer, of fifty-six octavo pages, covers Quarters, mess-halls, kitchens, sinks, etc, "Health of men as affected by conditions of tunnels, Character and safety of appliances for working shafts, Method of work in tunnels, Ventilation, and Accidents."

The quarters for Americans and Irish along the line are said to be good and adequate. Mess-halls and kitchens clean, food plenty, of good quality, well cooked and served. Those for Negroes, Hungarians and Italians not so good, the latter generally filthy. Sinks some distance from quarters, and care taken to

keep the drinking water from contamination.

The Negroes, Hungarians and Italians generally board and lodge themselves.

The health of the men seems more affected by the state of the ventilation, than by any other circumstance, as despite the necessary dampness of the tunnel, there does not seem to be much sickness from that cause, and the ventilation is spoken of as follows: "The lack of sufficient ventilation in the tunnels is the most serious evil to which the men are exposed. From one to two hundred pounds of dynamite are discharged daily in each heading, producing great quantities of smoke and gases. The air of each tunnel is also fouled by the smoke and products of combustion from many torches and lamps, and as previously said, by the men and mules." Forty or more men and two mules are employed at each heading. These forty men and two mules will exhale 35.47 cubic feet of carbonic acid gas per hour, which would defile 177.350 cubic feet of air besides the nitrous oxide gas and carbonic acid from the blasting, and the exhalations from the excreta of the mules and men, and, the carbonic acid and soot given out by the torches and mining lamps of the men. All these produce a highly poisonous state of the atmosphere, so that men are liable to be asphyxiated, or "knocked out," as it is termed on the work.

In addition to this, in some of the headings, notably those in which electric lights are not the main reliance for illumination, it is impossible to run lines, so that a correspondence has been in progress between the chief and other engineers on the one hand and some of the contractors on the other, on this subject since February 11th, which, so far has not resulted in any marked improvement.

A further danger from this bad ventilation lies in the fact that it is often impossible on account of the smoke, to see the roof, and a large part of the twenty seven accidents (4 fatal) from rock falls, (which amount to twenty-six per cent. of all the accidents) may be confidently ascribed to this cause.

As neither the power of the State Board of Health nor that of the Aqueduct Commissioners can apparently improve affairs, it might be well to invoke the aid of the Knights of Labor in behalf of the men, and the Society for the Prevention of Cruelty to Animals in behalf of the mules, and if these resources fail, some assistant might refuse to "measure up" until the tunnel atmosphere was satisfactory. We have known considerable changes to be made by such a course and then it would be interesting to the taxpayers of the city to know if the contractors have sufficient "pull" with the commissioners to secure the discharge of an engineer who adopted a recourse not entirely unknown in works that are not controlled by a commission.

According to those using them there is a great difference in the effects of the explosives employed. "Ditman explosive, a form of nitro glycerine, is said to give off noxious fumes greatly affecting the men and causing vomiting. Forcite is much less noxious, and Rack-a-Rock least noxious of all, but it gives off large volumes of dense smoke and seems to affect the eyes."

The reported methods for ventilation are two, viz: by a trunk of about 2 square feet in cross-section extending to within about 200 feet of the face, which is entered near its inner end by a small branch from the pipe carrying compressed air. A jet of air from this, induces a current capable of removing 3,000 cubic feet of air per minute, but the trunk apparently lies along the floor without intakes from the roof and it is not the custom to run the ventilators for more than an hour or two at most after firing, relying on natural ventilation the rest of the time. The other plan is by aid of a spiral-riveted sheet iron pipe through which the air is *intermittently* exhausted by Baker blowers. Mr. C. L. Kaimbach, the inspector, reporting on these appliances to the Chief Engineer says they would be perfect if the problem were "how not to do it." Under the head of accidents, which are treated of at some length, both in the text and in tables, attention is judiciously called to the fact that the tunnel is the longest of its size in the world, being from 17 to 18 feet high and from 15 to 16 broad, with an average cross section of 240 feet, and it may be added that the organization necessary to work 32 shafts, varying in depth from 28 to 350 feet with 54 or 55 headings, can not be made immediately as effective to prevent disaster as one on a smaller scale could be. The average weekly progress has been since Jan. 1st: Brown & Howard 39.2 feet, maximum 44.3; O'Brien & Clark 32.2 and 41 feet; Heman Clark 35.9 and 44.2. The probable average number employed has been about 4,250 of whom 3,500 work underground.

There can be but little doubt that a better organization and more care would have saved many accidents; particularly would the lives of the last five men killed by the follower at shaft three have been saved. Both of these accidents were described and commented on in our issue of last November 7th.

The following tables from the report give all the data of interest regarding the accidents with the Health Board's ideas as to their preventability.

It is to be regretted that it was necessary to write the report so hurriedly and that time enough to discover the relative amounts of atmospheric contamination from the different blasting compounds used, could not have been afforded. A few analyses of the air in each heading after blasting would have given engineers and contractors much valuable and exact information, which is now only loosely compiled by noticing the intensity and duration "of a nitro glycerine headache."

TABLE I.

Summary of Accidents on the New Aqueduct from May 1, 1885, to April 1, 1886. Classified by Contracts, Men Employed and Work performed.

	Fatal.	Non-fatal.	Total.	Aver'ge No. of men empl'yed.	Total lin. ft. of tunnel exc'vted.	Tons of rock exc'vted.	Average depth of working shafts or slopes.	No. of headings working.	Average rate of pro gress per mo. in lin. ft. per working heading.
Smith & Brown, gate-houses	..	3	3	76	.....	.....	.....	...	...
Brown, Howard & Co	18	31	49	1,431	24,478	500,000	177	20	183
O'Brien & Clark	12	22	34	1,194	18,415	389,000	58½	15½	151
Heman Clark	4	7	11	642	11,781	227,300	108	9	166
Totals	34	63	97	3,343	54 704	1,096,300	*122	44½	449

*Average depth for entire work.

TABLE II.

Accidents Classified as to Cause and Preventability.

From May 1, 1885.		Smith & Brown.	Brown, Howard & Co.	O'Brien & Clark.	Heman Clark.	Totals.
Cause.						
With buckets	Fatal	.....	10	1	.....	11
	Non-fatal	.....	2	1	.....	3
With cages	Fatal	.....	1	1	2	4
	Non-fatal	.....	1	2	.....	3
With cars	Fatal	.....	1	.....	.....	1
	Non fatal	.....	4	.....	3	7
From rock falls	Fatal	.....	1	2	1	4
	Non-fatal	2	7	12	2	23
From explosions of old holes	Fatal	.....	4	.....	.....	4
	Non-fatal	.....	4	.....	.....	4
From explosions while charging	Fatal	.....	.....	3	.....	3
	Non-fatal	.....	1	.....	.....	1
From explosions of powder-house and blasts	Fatal	.....	.....	1	1	2
	Non-fatal	.....	1	3	1	5
From falls of men	Fatal	.....	1	1	.....	2
	Non-fatal	1	3	2	.....	6
From machinery	Fatal	.....	.....	3	.....	3
	Non-fatal	.....	4	1	1	6
From miscellaneous causes	Fatal	.....	.....	.....	.....	.....
	Non-fatal	.....	4	1	.....	5
Preventability.						
Preventable by proper methods of working	Fatal	.....	8	.....	.....	8
	Non-fatal	.....	2	.....	.....	2
Preventable by proper supervision by contractor	Fatal	.....	6	6	.....	12
	Non-fatal	.....	13	7	1	21
Possibly unavoidable	Fatal	.....	.....	2	1	3
	Non-fatal	.....	5	7	1	13
Personal carelessness of men	Fatal	.....	4	3	2	9
	Non-fatal	.....	9	6	3	18
Purely accidental	Fatal	.....	.....	1	1	2
	Non-fatal	3	2	2	2	9

TABLE III.

From May, 1885, to April 1st, 1886.	Smith & Brown.	Brown, Howard & Co.	O'Brien & Clark.	Heman Clark.	The whole Aqueduct.
Percentages of total accidents under each contractor:					
Fatal	.....	53	35	12	100
Non-fatal	5	49	35	11	100
Number of men employed to each accident:					
Fatal	.....	80	100	161	98
Non fatal	25	46	54	92	68
Death-rate from casualties per 1,000 men	.....	13 6/7	10	6 2/3	10 2/7
Non-fatal accidents per 1,000 men	39 1/5	21 1/5	18 1/5	10 1/5	18 1/5
Lineal feet of tunnel run per man killed	.....	1,366	1,397	2,945	1,669
Lineal feet of tunnel run per man injured	.....	790	853	1,653	868
Tons of rock excavated per man killed	.....	27,778	30,750	56,825	33,714
Tons of rock excavated per man injured	.....	16,129	16,779	32,471	18,196

PERSONAL

EDWARD J. BARNES, has been appointed City Engineer of Dayton, O., to succeed Joseph E. Waltz.

A. R. GEYER, C E., of Paulding, O., was married on the 6th inst. to Miss Maud E. Crawford of that place.

HORACE ANDREWS is the new city engineer and surveyor of Albany, N. Y.; he has appointed John J. O'Hara his deputy.

COL. JOHN G. MURRELL, Chief Engineer of the Fort Worth and Denver R. R., has resigned to accept the position of Chief Engineer of the Chicago, Burlington & Southern R. R.

J. M. MEADE, has been appointed Assistant Engineer of the Atchison, Topeka & Sante Fe R. R. by Mr. Osborn, Superintendent of Roadway and Bridges. He will have charge of engineering in the operating department, with headquarters at Topeka Kan.

P. L. CABLE, one of the first directors of the Rock Island R. R. ex-president of the Canada Southern R. R. and president and director of several other roads died suddenly of consumption at his ranch near San Antonio, Texas, May 22, aged 68.

CHIEF ENGINEER MATTHEWS, of the Long Beach Water Works, started last Saturday night to walk over the trestle from the beach to East Rockaway. He was caught in the storm, and during a vivid flash of lightning he made a misstep and fell into the water at Wreck Lead. He was drowned, and his body has not been recovered. Two watchmen of oyster-beds saw Matthews fall through the trestle, and they incline to the opinion that he was struck by lightning. They were too far away to be able to render any assistance.

E. F. LOISEAU, the inventor of artificial compressed fuel, died at Brussels, Belgium, April 30. He was a member of the Franklin Institute, American Institute of Mining Engineers, Institute of Mechanical Engineers; Engineer's Club and other societies. Mr. Loiseau came to this country from France many years ago. He conceived the idea of manufacturing fuel from coal waste and pitch, and obtained a patent for his invention in 1874. He started a factory at Mauch Chunk, and after three failures, in 1883 the works were destroyed by fire, causing a loss of $50,000. Shortly afterward he went blind. He went abroad to erect machinery for the largest Belgium colleries to make the compressed fuel from their waste.

New England Water Works Association.

The fifth Annual Convention will be held at New Bedford, Mass., June 16, 17, and 18, 1886.

Owing to the *limited* hotel accommodations, it is highly important that all intending to be present should have rooms secured for their use at once. Mr. James H. Hathaway, Water Registrar, New Bedford, will attend to this matter, and all communications relative to the same should be addressed to him.

Programme of the Convention includes, Reception of the reports of special committees: 1. Report of committee on "Revision of Constitution." 2. Report of committee appointed to obtain "Information relative to Cast Iron Pipe." 3. Report of Committee on "Uniform Methods of Classification of Water Rates." 4. Report of Committee on "Exchange of Sketches," Distribution of Sketches. Reading and discussion of Paper: "The Discharge of Mains as Determined by the Pressure Gauge," by Geo. A. Ellis, C. E.; Questions and Answers. Election of Officers. Reading and Discussion of Papers: "Information relative to the Best Type of Water Power Pumping Machinery," by Col. J. T. Fanning, C. E.; "Rainfall; the Amount Available for Water Supply," by Desmond Fitz Gerald, C. E. Reading and Discussion of Papers: "Water Waste," by Dexter Brackett, C. E. "Proportions and General Treatment of Artificial Reservoirs," by Alphonse Fteley, C. E. Questions and Answers relative to Sketches. Discussion of Miscellaneous Topics. Adjournment.

Friday, June 18.—In acceptance of an invitation from the City Government and Water Board of New Bedford, the convention and guests will assemble at the Water Board office, City Hall, at 8 o'clock, *sharp*, when they will take carriages and barges for a drive to different parts of the city, making a short stop at the "distributing reservoir," arriving at the pumping station at 10.15.

The party will be joined at this place by those guests who may arrive on the train leaving Boston at 8.30.

An exhibit of the pumping facilities will be made. The new Worthington "high duty" engine will be in operation, and courtesies will be extended to the members of the Association by Henry R. Worthington.

The party will take a special train, which will leave the pumping station at about 12 o'clock, conveying them to the steamboat wharf. The steamer will leave at 12.15 for a sail in the waters of Buzzards Bay, returning in season to connect with the trains leaving steamboat wharf about 3.15 for Boston and Providence.

A collation will be served on the boat.

ROBERT C. P. COGGESHALL, *President.*
ALBERT S. GLOVER, *Secretary.*

West Newton, Mass., May 24, 1886.

CORRESPONDENCE.

Davis Island Dam Correction.

U. S. ENGINEER OFFICE,
PITTSBURG, PA., May 20th, 1886.

EDITOR ENGINEERING NEWS:

In the publication of the article on the Davis Island Dam, in your issue of the 15th there was an error in the title of two of the illustrations, viz.: The cross section of Gate Recess (through a valve) represented on page 307 and the cross section of Movable Dam, on page 308, you have the titles reversed, that on page 307, should be cross section of gate recess (through a valve) and that on page 308 is the cross section Movable Dam. By making this correction you will oblige, yours,

Very respectfully,
WILLIAM MARTIN.

A Bridge Question.

FITCHBURG, MASS., May 19, 1886.

EDITOR ENGINEERING NEWS:

Referring to "A Bridge Question," by W. C. Kernot, on page 305 of ENGINEERING NEWS and to the diagram accompanying it, the tensile strain on *A B* when the bridge is fully loaded with forty-seven tons, would be, in round number, sixteen tons. As the breaking tensile strain of American iron is usually about twenty-five tons per square inch, the rod, *A B* is not large enough for safety provided the bridge ever becomes fully loaded with seventy-five pounds per square foot.

WM. H. BAKER.

Keeping Right of Way Clear of Vegetation.

EDITOR ENGINEERING NEWS:

Apropos of the report of the State Geologist of New Jersey, the current number of the *Nation* has the following paragraphs:

"One railroad has devised a plan of keeping 100 feet on each side free from combustible vegetation, an end which by the way, in the case of a southern railroad some forty years ago, was sought to be obtained by scythes attached to the axles; until the expedient naturally resulted in the loss of human life."

Can any of your readers give us some details of the plan used by the New Jersey railroad thus referred to, it may be of advantage to other roads.

I should like to know something more of the scythe-bearing axles of the southern railroad; I am little doubtful if such an experiment has been tried since the Britons drove their scythe-armed chariots against the invading Romans.

Yours, W.

Frogs and Switches.

IRVONA, CLEARFIELD CO., PA, May 19, 1886.

EDITOR ENGINEERING NEWS:

What points are measured in lining a lead by a cord, and what distance at each point?

How is the number of a frog ascertained? J. P. S.

[Instead of using a cord to measure offsets from, in lining the lead rails to a frog, it is better to take the main rail of the track (from which the turnout is to be laid) as a tangent to the turnout curve and to measure at convenient distances, about every 10 feet, ordinates to the curve. These distances can be marked on the ties with a piece of chalk, and the lead rails spiked down in accordance. A two foot rule is the only instrument required. This method is fully explained in Track, pages 68-69, where a table of ordinates for different frog numbers is given.

The number of a frog is the product of the length of the "point" divided by its width. This is also explained in Track, on page 45.—ED. ENG. NEWS.

Ventilation of Sewers.

OMAHA, NEBRASKA, May, 19th, 1886.

EDITOR ENGINEERING NEWS:

In your issue of May 15th, an article begins as follows: It would seem unnecessary in this age to bring forward any argument in proof of the fact that it is an unsanitary and dangerous practice for city and town authorities to neglect the proper trapping of sewer inlets, etc.

So much has been said upon this subject that I thought a few words concerning our experience in Omaha might be of interest. One portion of the city is sewered strictly on the Waring system, and no trouble has ever been caused by sewer gas, and no examination of either main or lateral has ever disclosed any. The remaining portion all drains into two eight and one-half (8½) feet brick sewers built to intercept two creeks flowing through the city. On these mains, at every street corner requiring it, catch-basins are built, and connected with the sewers without any intervening trap. On one sewer there arose considerable complaint on account of a stench arising from these basins. This stench, as was contended by City Engineer Rosewater and myself, came from the residuum arising from the manufacture of water gas and discharged into the sewer by the gas company, but the public were incredulous and learnedly discussed the question of sewer gas. Last fall the gas company built an independent sewer of their own discharging all of their sewage into the river direct, and since that time *no complaint* has ever been nor can be made.

Some few weeks ago it became necessary for me to make an examination of the upper portion of this same sewer, where there is no flow except sewage and the discharge of flush tanks, and no trace of sewer gas whatever could be discovered—the elevations of the sewer at this point is 100 feet above the outlet—and I actually believe that the air in that sewer to-day would analyse better than that of many of our crowded school and court rooms. All the pipe branches of this sewer are provided with flush tanks discharging twice per day, which gives a regular flow in a 3 feet sewer. This, with the thorough flushing received in a heavy shower, has always served to keep our sewers almost absolutely clean.

I should be very glad to hear from other engineers on this subject. Very truly yours,

GEO. W. TILLSON, C. E.,
Engineer in Charge of Sewerage.

The Suburban Rapid Transit Railroad.

The first section was opened on the 17th for travel quietly and without any speeches. The road was organized under the provisions of the Rapid Transit Act by commissioners appointed by Mayor Cooper on March 6, 1880. The routes authorized by its orignal charter, together with those since acquired by lease, comprise twenty miles of lines in that part of New York City which lies north of the Harlem River. Only a small portion of these lines is along streets, the greater part following the routes expressly designated for steam railroads on the plans for laying out the "annexed district," prepared by Mr. J. J. R. Croes, the Civil and Topographical Engineer of the Department of Public Parks in 1877, and adopted by the department. These routes lie through the centres of blocks, over which the railroad company purchases its own right of way.

The advantages of this system are seen in the portion of the Suburban Road which is now ready for travel, the structure being composed of massive plate-iron girders resting on brick piers, and capable of carrying heavy trains at high speed with less noise than is made by the elevated railroads in the streets south of the Harlem River, while the cost of the structures is considerably less than that of the street roads.

The railroad begins on the south side of the Harlem river, where connection is made at 128th street with the Second avenue line of the Manhatten Elevated Road. The river is crossed on a handsome drawbridge, at an elevation of 32 feet above mean high water, and the road then passes over the freight yards of the Harlem River & Portchester railroad, on a lofty iron viaduct, on which four tracks are provided, two of them descending to form a connection with the surface-tracks of that railroad, and enable passengers on its line from Morrisania to New Rochelle to be landed directly at the transfer station of the Second Avenue Elevated Road. The other two tracks proceed northwardly between Alexander and Willis avenues to 143rd street, where two lines diverge, one going northeastwardly for four miles to West Farms and the Bronx Park, the other going westwardly and northwardly to Jerome Park, with branches on Third avenue, and to a connection with the New York City & Northern railroad at their bridge opposite Eighth avenue.

The drawbridge at Second avenue and a mile of the stem line have been constructed, and it is announced that contracts for several miles of the road will be let at an early day, the plans and specifications being nearly ready and the arrangements made.

Trains will be run at present from 5:30 A. M. to 9 P. M., at frequent intervals, between the transfer station at Second avenue and 134th street, and in about ten days will run to 143rd street.

The numberless obstacles which are thrown in the way of any new great enterprise in New York City have been patiently overcome by the quiet and persistent management of Mr. Samuel R. Filley, the president of the company, to whom is due the credit of having put on a solid basis this important company and of having had built in the most economical and substantial manner works which cannot be valued at less than a million dollars, and are well worth what they have cost. Mr. Croes, who designed the general scheme of the work while in the Park Department, and was one of the engineers of the Rapid Transit Commission which established the routes, has been the Chief Engineer of the company since its organization, and had charge of all its plans and constructions.

In the designing of the iron structures he has had the services of the well-known iron bridge expert, Mr. Theodore Cooper, and as resident engineer on the construction, Mr. H. W. B. Phinney, whose efficient service is sufficiently attested by the excellent character of the workmanship.

Concerning Tile.

An extensive manufacturer of tile says that about a year since a farmer came to him to pay for his tile, and said that he thought tile drains would last longer than they do; he said: "Those tile I got of you seven years ago did first rate for three or four years, and then commenced to give out, and now they only drain about one-third the distance at the lower end." I learned that he put the tile in without having water to grade, and did not level his ditch. I advised him to put seven-inch where he had three-inch and put them in twice as deep and grade by water. I think I would be safe in saying that one-half to one-third of all the tile that has been put in to the present time will have to be taken up and laid more perfectly. Not until within the last few years have tile been put in any thing like deep enough, and especially that which was put in first; the drains were mostly not graded—a great many supposed that the force of the water would keep them washed out whether it was graded or not: but after a few years they found that the three-inch tile, put down one and one-half feet deep across the ten-acre field, did not thoroughly drain the whole field.

Railway Construction in China.

Some amusing information is to hand from the land of the Celestials respecting the doings of the rival syndicates at work in that country with the view of securing railway concessions. Three Richmonds are in the field—one from Germany, one from France, and one from the United States. General Wilson, the representative of an American railroad ring, has spent all the winter assiduously flattering the Chinese. A correspondent writing from Pekin describes him as a distinguished cavalry officer, who wears a splendid uniform. He has made a considerable impression on the Chinese; made a journey during the winter to the Yellow River, with the approval, if not at the request, of Li Hung Chang, and on his return he presented a report on the management of that most unmanageable of rivers. Such things, the correspondent adds, do not present the same difficulties in China as they do in other quarters of the globe; like "good words" they are worth much though they cost little; and on the strength of the Yellow River report General Wilson reckons to establish a claim to build railroads in China. No doubt General Wilson looks upon himself as a "smart man," but it takes more than a cute Yankee to beat the "Heathen Chinee" in the slippery sphere of diplomacy. Prince Bismark never does things by halves, but it looks as if he has overdone it in this Chinese railroad business. Over-covetous people clutch at things, and the greediness exibited has scared the Chinese. First of all he got the German representative at the Court of Pekin, M. Von Brandt, to go to work with a will to create an impression. His efforts, however, were attended with little success. He was no match for the brilliant American general. Six months ago, says the correspondent, the conclusion was forced upon him that if railways were then to be begun the construction of them would be entrusted to other hands than those of any of his countrymen, whereupon he turned round and wrote a very able paper, which was communicated privately to the highest Chinese, to demonstrate that railways were quite unsuited to China in its actual circumstances. This representation had much more effect than all his previous representations in an opposite sense. But now his monster has come home to roost, and by directions of Bismark the unfortunate Minister has to perform another *volte face* and prove to the Chinese Government that railways are the one thing needful for the safety of the country. A German syndicate sent out three representatives bearing letters from Prince Bismark to back him up, and these gentlemen are still trudging about the country paying court to this minister and to that. They state they represent £35,000,000, though no doubt 35 million marks would be nearer the "mark." France, too, is in the running, but Chinese susceptibilities are too tender in that quarter to afford her a chance. Although the three syndicates claim to represent £100,000,000. The Chinese have but to say the word, and this sum will be poured into their country by benevolent Christendom. Meanwhile all this philanthropy has made the Chinese Government very suspicious. And no wonder. The probability is that it has thrown back railroad construction in the country for a good many years. This result all true lovers of the country would regret, and among the most disinterested friends of China we may place the British Nation. China wants railways, but she does not want their construction to be the means of introducing foreign yoke and foreign interference. She knows that astride of a German steam engine would sit Prince Bismark; she dare not trust France; she has but to look at the swindling in connection with American railroad construction to know what capitalists from that quarter would do. We do not claim a monopoly of honesty for contractors and company promoters here, but this we may say, that in no other country is to be found such adequate means and general probity. The work done here at home, in India, South America, Australia, Canada and Asia Minor speaks for itself. We have no political designs to cover, and we have long since abandoned the dictum of backing up abroad the quarrels of private traders. From us the Chinese, politically speaking, have nothing to fear. We can offer them the maximum of advantage with the minimum of risk.—*Herapath's Journal.*

A Miner's Inch of Water.

Concerning the history which involves the present definition of the term "a miner's inch," Prof. Henry G. Hanks, State Mineralogist of California, remarked some time ago:

The term, "a miner's inch of water," is of California origin, having grown out of the method of measurement here adopted by the ditch companies in disposing of water to their customers. "A miner's inch of water" varies in different localities to such an extent, that it may almost be said to constitute an arbitrary quantity. This arose from the practice that obtained in the early days, whereby each ditch company having water to sell, fixed the quanity to be represented according to such standard as best suited itself, and which, coming to be generally recognized, grew at last into a custom having the force of law in that locality. Hence the disparity in this respect, that prevails throughout the the mining districts of the State. In the delivery of water the varying elements consist of the head or pressure, and the size of the aperture.

The "miner's inch" that has come to be most widely accepted is the quantity of water that will flow from an orifice 1 inch square through a 2-inch plank, with still water at a depth of 5 inches above the top of the orifice. Through a plank so perforated 2,274 cubic feet feet of water will escape in twenty-four hours—say, 17,000 gallons. Where this method of measurement is adopted a long horizontal slit, 1 inch high, is made in the discharge-box, a slide being used to regulate the number of inches which it is intended shall escape. This being a simple and convenient arrangement for determining the quantity of water delivered, accounts, in part, for its popularity. At Smartsville an opening 250 inches long and 4 inches wide was used for measuring the water delivered under a pressure of 7 inches above the top of the opening, the discharge so effected being 1,000 "Smartsville" inches. This flow is equal to 1 76-100 cubic feet per minute, or, say, 19,000 gallons in twenty-four hours.

The South Yuba Canal Co. discharge water through a 2-inch aperture in a 1¼-inch plank, under a pressure of 6 inches measured from the center of the aperture, while the North Bloomfield, the Milton, and the La Grange companies calculated the inch by a flow through an opening in a 3-inch plank, 50 inches long and 2 inches wide, the water standing 7 inches above the center of the opening. The Eureka Lake and Canal Company adopt an orifice 2 inches high, under a pressure of 6 inches: if this orifice be 10 inches long, 20 inches of water escape. In some cases the water is delivered under a pressure

of not more than 3 or 4 inches, and occasionally without any pressure at all.

A series of experiments were made by A. J. Bowie, Jr., C. and M. E., to determine the effective value of the "miner's inch," under the following conditions: Water discharged through a rectangular aperture 50 inches long and 2 inches wide, in a 2-inch plank, and under a pressure of 7 inches above the center of the opening. Result approximately: 1 miner's inch discharged in 1 minute, equivalent to 1.50 cubic feet, equal to 12 gallons; 1 miner's inch discharged in 1 hour, equivalent to 90 cubic feet, equal to 700 gallons; 1 miner's inch discharged in 24 hours, equivalent to 2,160 cubic feet, equal to 17,000 gallons.

YELLOW brick and stone does not do well in this climate. Out west, where the air is dry, white and yellow stone surfaces keep their color. But in our moist atmosphere, impregnated as it is with salt, light-colored brick and marbles soon become soiled and unsightly. There are instances of this all over the city, as witness to building on the corner of Thames street and Broadway, also the structure on the northwest corner of South William and Beaver streets. The new Cotton Exchange is destined, we fear, to become discolored in the course of time. It is a beautiful and cheerful-looking edifice, now that it is new, but it cannot be expected that it will long retain its cleanly and sunny exterior. The marble foundation is already an eye-sore, for the stone contained some oleaginous substance which the pressure and the atmosphere have drawn to the surface, giving it a most unsightly appearance. It is said that in the course of time the oil will be all extruded, and the surface will be as clean as other granitic marbles. In this climate architects and builders should bear in mind the effect of moisture, salt and smoke upon light-colored stones or brick.—*Record and Guide.*

THE astounding growth of the business of supplying natural gas is shown by the annual report of the Philadelphia Gas Company, of Pittsburg. The significant facts are that it has increased its capital stock from $1,000,000 to $5,000,000; that its gross earnings for the first three months of 1886 were $387,482; expenses, $115,193, and net earnings, $272,286, and dividends, $150,000, or three per cent. on the capital.

THERE are multiplying indications that a boom lies close behind the lines of business operations. As long as the tariff tinker, the boycott and the anarchist are strong enough to hold it back, however, they will certainly do it. Prosperity means death to demagogues and disorder.—*Philadelphia Press.*

WATER

NASHVILLE, TENN., contemplates building a new reservoir at a cost of about $200,000.

BURLINGTON, Io.—A syndicate of eastern capitalists has made a proposal to purchase the Burlington water-works.

THE Holyoke, Mass., water commissioners have received about half of their season's supply of pipe, and the remainder will arrive later on. They have ordered in all, 8 000 feet of 16-inch, 4,000 feet of 6-inch, and 2,000 feet of 4-inch pipe.

St. SAUVEUR, Quebec.—It is probable that the municipality will shortly have a system of water works of its own. Mr. Hoare, the engineer, has been requested to prepare certain plans, and if the cost of executing the same is not entirely too high the corporation will seek authorization to borrow for this purpose on debentures the sum of $200,000.

THE Mansonville, Quebec, Aqueduct company is to apply for incorporation, with the intention of supplying that town with water, Messrs. Abel Hammond, George Manson, L. A. Perkins, N. Boright and Dr. McMillan being provisional directors. The capital stock is fixed at $2,500.

UTICA, May 21.—The contracts for the Little Falls water-works involving $226,000 were awarded to-day as follows: Conduit and upper reservoir, Sherman & McDonough, Utica, about $47,000; distributing reservoir, Halleman Bros., Little Falls, $20,777; street distribution, T. Sullivan & Co., Syracuse, amount not stated. The work is to be finished in 1887.

IDAHO SPRINGS, COL. May 22.—The north pier of the Becker dam has commenced to give way under the great pressure of water, and if something is not soon done to save it from going out, immense damage may result to county bridges and to the railway line of the Colorado Central Railway Company.

No. 17. Water Pressure in Mains of Various Cities.

COMPILED BY J. J. R. CROES. FROM SPECIAL RETURNS, JAN., 1886.

TOWN AND STATE.	Topography.	Difference of level in town.	In Business District.		
			Day Pressure.	Night Pressure.	Fire Pressure
		feet.	lbs.	lbs.	lbs.
Holly, Mich.	level.	10	30 to 40	30 to 40	75 to 150
Homer, N. Y.	level.	0	90	95	———
Las Vegas, N. M.	rolling.	———	110 to 130	130 to 145	130
Lee, Mass.	undulating.	25	80	90	80 to 90
Leominster, Mass.	hilly.	50	79	80	80
Marshall, Mo.	level.	———	60	50	50 to 150
Marshalltown, Ia.	rolling.	60	40 to 45	———	80
New Bethlehem, Pa.	level.	0	85	85	85
New Britain, Conn.	hilly.	200	65	80	65 to 80
New Castle, Pa.	rolling.	———	112	112	———
Oskaloosa, Ia.	level.	———	25 to 30	20 to 25	70 to 90
Owego, N. Y.	hilly.	———	100	100	100
Perth Amboy, N. J.	level.	0	42½	42½	42½ to 100
Peterborough, Ont.	hilly.	70	50 to 70	50	80 to 110
Petrolia, Pa.	hilly.	100	30	60	400
Reno, Nev.	hilly.	———	65	65	65
Richfield Spr'gs, N.Y.	hilly.	———	75	75	75
Salem, N. C.	———	———	80	80	200
Salida, Col.	sloping.	10	65	65	65
Salinas City, Cal.	level.	0	30	40	30 to 40
Thomaston, Conn.	hilly.	50 to 75	125	130	125 to 130
Three Rivers, Que.	level.	20	85	60	130
Warren, Pa.	level.	———	70	75	135
Warren, R. I.	level.	0	60	70	———
Warsaw, N. Y.	level.	———	128	———	———

BRECKENRIDGE, Colorado.—The Board of City Aldermen are contemplating the construction of self-sustaining water works to take the place of the present system, and they held a special meeting recently to debate the subject. The water tank will be about 2,000 feet from the main street and have a fall of 201 feet with a pressure of ninety pounds to the square inch.

HAMILTON ONT.—The city engineer and the mechanical engineer at the water-works pumping-house have received instructions from the City Council to visit the principal cities in the States to gain information regarding the most improved pumping machinery in use. The city purposes spending $70,000 to increase her pumping capacity.

HASTINGS, NEB., May 18th.—The water-works contract was let to-day to A. L. Strang & Co., of Omaha, the amount of the contract being $76,000. This is on a basis of a stand pipe 18 inches in diameter and 127 feet high, eight tubular wells with a vertical pumping engine to each, one compound duplex engine and one high pressure duplex engine. Mr. Strang's bid was the only one for a complete system.

MONTREAL, CANADA.—New and larger water mains are to be laid in the business district. With the hydrant couplings there will be about 11,000 feet of new mains. In connection with the new mains, it is proposed to establish twenty-four new hydrants of very large size, which Mr. Lesage, the Superintendent, claims will be more effective for furnishing water for steam fire engines than the proposed tanks. The new large mains it is proposed to connect at their extremities with the existing system, which will derive great benefit throughout from the increased pressure.

PHILADELPHIA WATER-WORKS EXTENSIONS.—The Joint Committee on Water of Councils met May 18, and considered suggestions by Chief Engineer Ogden for the expenditure of the $496,000 appropriated by Councils for the improvement of the water supply. The Chief Engineer proposed that the money be expended as follows:

For one 20,000,000-gallon pump and engine at the Spring Garden Works, $100,000; two steam boilers at the Roxborough Works, $7,500; a 48-inch main from Spring Garden engine-house to Twenty-fourth and Parrish streets, 5,400 feet, $72,000; a 48-inch supply main from Twenty-fourth and Spring Garden streets to Twenty-first and Bainbridge, 8,800 feet, $110,000; a 36-inch main on Bainbridge, 3,300 feet, $28,000; a 36-inch main on Bainbridge street from Twenty-first to Twenty-second, $3,300; a 20-inch supply main on Broad street, from Snyder avenue to Wolf street, 960 feet, $3,500; a 16-inch pumping main on Allen's lane, from Germantown road, south, 1,200 feet, $2,000; a 30-inch main, from the southeast to the northeast corner Roxborough reservoir, 510 feet, $2,500; for relaying 16-inch supply main on North College avenue, from Twenty-second street east, 1,200 feet, $3,000; for a 36-inch supply main on Lehigh avenue, from American to Kensington avenue, 3,100 feet, $26,000; for a 30-inch main on Lehigh avenue, from Kensington avenue to Cedar street, 3,600 feet, $21,500; a 20-inch main on Girard avenue, from Front street to Otis street, 3,500 feet, $12,000; a 12-inch pipe on Girard avenue, from Front to Lawrence streets, 2,200 feet, $4,500; for relaying pipe that is less than 6 inches in diameter with large pipe in the old city and the district of Southwark and Movamensing, $60,000; for replacing old and small pipes in the Sixteenth, Seventeenth, Eighteenth, Nineteenth, Twenty-fifth and Thirty-first wards with suitable pipes, $40,000. The suggestions were approved by the committee, and the Chief Engineer was instructed to prepare specifications for the new pumping engine at the Spring Garden Works.

NEWARK, N. J.—The committee on water supply has had under consideration several suggestions as to new sources of supply, and has inspected the working of the Hyatt filter used to purify the Raritan water, which is very dirty: the water is pumped from the river into a stand pipe 145 feet high, from which the pressure is obtained, the capacity being 82,000 gallons. From the pipe it is conducted into the filters, and from thence into the mains. The working of the filter in all its parts was shown. The sand was washed automatically and replaced in the filter proper by hydrostatic pressure, the operation requiring about twenty minutes.

JACKSONVILLE, ILL.—The revenue for the Water-Works last year was $8,812.36, an increase of $810.27 over any previous year, while the amount of water pumped was 8,000,000 gallons less and the coal bill $192 less. This reduction is stated to be due to the introduction of meters. The Jacksonville *Herald* says: "When it is measured, leaks are more carefully looked after as well as useless extravagance and in addition, a vast amount is gained by the city as the wear and tear of the expensive machinery at the works is a prominent item in the expense of raising water. We certainly think the question of the use of meters for all consumers should have careful attention."

GALESBURG, ILL.—In the case of the Farmers Loan and Trust Company, of Chicago, against the Galesburg Water Company, a decree of foreclosure and sale has been entered. On August 1, 1883, the Water Company gave a mortgage of its franchise and property to the Farmers Loan and Trust Company to secure an issue of $150,000 of bonds. Of these only $125,000 were issued. There has been no interest paid on any of the bonds since February last, and there is now due for principal and interest $14,737.50. The property, which includes all the property, water mains, works, etc., and its franchise under the ordinance of the city of Galesburg, is to be sold by Master in Chancery Henry W. Bishop, at the postoffice after three weeks notice in some Chicago paper.

THE WATER SCHEMES FOR ADELAIDE.—Adelaide seems to be a long while making up its mind as to which of the many schemes for a water supply it has had before it is the best one to adopt. The report of Mr. Culcath, of Victoria, upon the subject is said to be very satisfactory. He is in favor of the Barossa Water-works scheme, and recommends it as being superior to the Sixth Creek and other schemes that have been proposed, but he does not think it necessary that it should be carried out on such a colossal scale as has been asked for. He further suggests that the water should be conveyed from the Barossa Reservoir into the Hope Valley Reservoir, instead of being brought direct from Barossa to Adelaide. This work will involve a considerable expenditure, both for labor and plant.—*Colonies and India.*

THE Ohio Senate has passed bills authorizing Dayton to issue bonds to enlarge sewers, and Wellsville to issue bonds to build water-works.

ROADS.—G. E. Morrow, of Champaign, says of road-repairing: Most of all does it need to be impressed on many in authority that it is a great waste to keep up the system of letting the roads alone except once a year or when they become impassable. Within a week I have been one of hundreds who have been bounced and jolted in farm wagon and light buggy over a leading road, the ruts in which were being slowly filled at cost of time, comfort, horse flesh and injury to vehicles, yet where a day's work by one man and pair of horses with any one of several road machines would have made miles of this road so smooth that to travel over it would have been a pleasure.—Lincoln, (Ill.) *Herald.*

BOSTON, MASS.—The committee on drainage made its first report on the report of the metropolitan commission recently. The bill provides that the State Board of Health shall have the general care of all inland waters, and may employ such engineers and clerks and other assistants as it may deem necessary, provided that no contracts or other acts which shall involve the payment of money from the treasury of the Commonwealth shall be made without an appropriation; it shall annually, on or before Jan. 10, report to the General Court its doings in the preceding year, recommending legislation and suitable plans for such systems of main sewers as it may deem necessary for the preservation of the public health; said board shall have authority to conduct experiments to determine the best practicable methods of purification of drainage or disposal of refuse arising from manufacturing and other industrial establishments. It shall from time to time consult with and advise the authorities of cities and towns, or with corporations, firms or individuals, either already having, or intending to introduce, systems of water supply or sewerage, as to the most appropriate source of supply, the best practicable method of assuring the purity thereof or of disposing of their sewage; all such new corporations, or individuals, are hereby required to submit for its advice, outlines of their proposed plans or schemes in relation to water supply and disposal of drainage and refuge. Said board shall bring to the notice of the attorney-general all instances which may come to its knowledge of omission to comply with existing laws respecting the pollution of water supplies and inland waters, and shall annually report to the Legislature any specific cases not covered by the provisions of existing laws which in its opinion call for further legislation.

CHICAGO WATER.—Every once in a while, and sometimes twice in a while, we see stories in the local papers about the reptilian specimens that make their Chicago debuts through the faucets in the dwellings of the élite. It is with no arrogant idea of competing with an enterprising daily press, that we submit the appended anecdotes garnered by our reporters in the course of their vigils in the cause of pure water and good government:

Daisy Maginnis, a wash-lady in the residence of Potiphar Porkchop, of Ashland avenue, recently drew a tub of water from the faucet in the kitchen, and what was her amazement to find in the water a half-grown specimen of the behemoth of Holy Writ, perfectly developed and very active. Barnum has bid for it.

Bebe Pumpernickel, a French nursery-maid in the family of Mrs. Obrion, of Obrion Villa, Lincoln Park, North, while giving little Raoul Obrion his morning bath, was astonished to find issuing from a faucet a boa-constrictor as large as a Bologna sausage. The reptile was in excellent health and very intelligent. Surely something should be done to prevent respectable Chicagoans from imbibing boa-constrictors in their drinking water.

While brushing his teeth at the pump in the back yard yesterday, Charley Smalldood pumped up a half dozen Little Neck clams. It would seem that when our water supply reaches this pass, it is high time that steps were taken to reduce the price of beer and soda water.

A full-grown ichthyosaurus was drawn from the faucet in Hon. G. Whilliken's kitchen, last week. It has been sent to the Mayor with a letter of introduction.

Miss Petite Muldoon of Dearborn avenue found a phœnix and a unicorn in a pitcher of drinking water, yesterday. Turn the rascals out.—*Rambler.*

THE Commissioner of Public Works Chicago, received the following suggestive letter recently, from Selz, Schwab & Co., manufacturers on Franklin street:

Dear Sir: Our engineer has been trying with very indifferent success to generate steam from fish, but even these have given out, and now nothing whatever comes through our water-supply pipes. Can you not kindly afford us relief? If you have not the water to spare please send on some more fish and greatly oblige,

yours, SELZ, SCHWAB & CO.

NORTH MUSKEGON, MICH., has now about three miles of water-mains, and an average of 80,000 gallons of water are pumped each day.

MASON AND TAZEWELL DRAINAGE DISTRICT.—J. H. McKinstrey, E. S. Starrett and D. C. White, the drainage commissioners of the great Mason and Tazewell special Drainage District were in town yesterday, accompanied by Hobart Hamilton, of Petersburg, the engineer of the drainage work in that district. They came in to register $12,000 more of the bonds issued to carry on this important work, the whole amount now registered being $223,000. The drainage district was organized December 19, 1882, to drain large tracts of marshy and swamp lands in Mason and Tazewell counties embracing 47,000 acres. The district is now about to be enlarged to take in 10,000 to 15,000 acres more. The contract was let in September, 1883, for excavating the ditches. The contractors were W. A. McGillis & Co. Work was commenced in the spring of 1884, the winter preceding being chiefly occupied in experiments on machinery. It is said that in these experiments alone fully $30,000 was expend, and they finally produced successful machines for such work and have been going ahead ever since. It was found that the law was insufficient to complete the work on the plan undertaken, and it was chiefly from the experiences of this drainage enterprise that the amendments to the drainage law were derived and effected at the last session of the Legislature.

The main ditch begins at the line between the towns of Delavan and Malone in Tazewell county, and runs nearly in a westerly course, and strikes Quiver creek at Forest City, Mason county, and thence runs southwest down the creek, about three miles, the creek furnishing the outlet into the Illinois river, making an entire length of main ditch of nearly 17 miles. This ditch is 55 ft. wide on the top and 10 ft. deep at the upper end, and widening out, is 60 ft. wide and 10 ft. deep at the lower end. It has nearly a uniform fall of 3 ft. to the mile. This is probably the largest drainage ditch in the United States, and certainly much the largest and best in Illinois. Of lateral ditches leading into this main ditch, for the purpose of draining all parts of the district, the following have already been dredged: The North Quiver ditch, five miles long, 30 feet wide and 7 feet deep, the Red Oak ditch, 8 miles long, varying from 18 feet to 30 feet in width, and 7 feet deep; the Allen's Grove ditch, five miles long, varying from 30 feet to 36 feet in width, and from 7 feet to 9 feet deep; the Ash Grove ditch, three miles long, 18 feet wide, and 7 feet deep; the Winkle ditch, three miles long, 16 feet wide, and 7 feet deep; the Wilson ditch, about three miles long, 16 feet to 18 feet wide, and 7 feet deep. This is a total of about forty-one miles of dredge work, the last of which will be done in about two weeks. There is still additional dredge-ditching to be done beyond what is detailed above, amounting to about seven miles. Besides all the dredge-ditches completed and projected, there are about thirty miles of scraper and spade ditches already completed, so that, when the work is done, there will not be a swale or pond in the entire district that will not have an outlet to the main ditch.

The cost of this great work, when completed, will not be far either way from $300,000. The value of it cannot be estimated. There are thousands of acres in the district, now readily worth $30 an acre, which, as marketable land, would not have brought $5 before the work was done; many are farming successfully this year on lands which formerly were great swamps through which cattle could only pass in the dry months of the summer, and cellars in the district that used to be wet and unhealthy, are dry and serviceable. The men who have been connected with this enterprise say it is a success in the fullest sense of that word, and they assert that the lands reclaimed are destined to be, from this time on, among the richest and most productive in the State. The improvement will be worth more than ten times what it cost. It is the first great and extensive drainage scheme successfully carried to a practical state of operation and completeness in this State, and admirably illustrates what the friends of practical drainage in Illinois, have been insisting upon for years.—Springfield Ill., *State Journal.*

NEWS OF THE WEEK.

CONTRACTING.

Proposals for Paving.—Bids for the eleven different streets paving contracts in this city are advertised in *City Record.* Bids to be opened June 9th.

Quarrying.—Bids for quarrying 500 cubic yards of rock for macadam at Burlington, Ia., were as follows: James Kelley, 65 cents. per yard; Fred Hoppman, 45 cents, and John Kline, 40 cents.

Brick Paving.—A correspondent of the Detroit *Free Press* advocates the Hon. John Greusel's system, consisting of hard burnt bricks soaked in boiling tar and laid on edge.

Paving.—The Brooklyn Mill and Lumber Company will put down several hundred feet of sidewalk this season using Ferroid concrete. Plymouth avenue, Buffalo, N.Y., will be paved with Ferroid and Medina stone this summer. Work will be commenced in July.

Brooklyn City Work.—The appropriation for the Public Works Department for the present year includes the following items: Cleaning and repairing sewers, $40,300; repairs to street, $250,000; docks, piers and dredging, $15,000; bridges, $24,500; wells and pump $28,600.

Chesapeake & Ohio R. R.—The contract to build the 140-mile extension from Ashland to Covington, Ky., has been let to the Mason & Foard Co., and D. Shanahan & Sons, of Louisville, Ky. The contract for the masonry for a bridge across the Ohio river at Covington has been let to the same parties.

Pipe.—For supplying about 100 lengths of 30-inch pipe to the Water Commissioners, Wilmington, Del., the following bids were received: Gloucester Iron Works, $27.35 per gross ton; Mellert Foundry and Machine Co., $26.50; Pancoast & Rogers, $28.50. The contract was awarded to the Gloucester Iron Works.

Bridge.—At Springfield, O., a new bridge is to be built to carry High street over the C., C. C. & I. and I. B. & W. railroad tracks, the old one having been destroyed by the late storm. The new structure will have a span of 98 feet and is estimated to cost about $27,000.

Railroad.—The contract for building the Atchison, Topeka and Santa Fé Railroad from a point four miles north of Fort Worth to Gainesville, Tex., has been awarded to Morgan Jones, who will immediately put a full force of men and teams on the work and complete the grade at the rate of three-fourths of a mile per day.

To Build the Hudson Bay Railroad.—WINNIPEG, May, 25.—The Legislature has cabled to the President of the Hudson Bay Railway, who is now in England, that this province will guarantee bonds of the road to the amount of $45,000,000, at 4 per cent., for twenty-five years; that work be commenced forthwith, the gauge to be equal in standard to the Canadian Pacific, and that the road must be completed in five years.

Court House.—The commissioners of Hampshire county, Mass., have awarded the contract for the new court-house at Northampton to Bartlett Bros. of Whately for $66,500. It is to be built of Dummerston (Vt.) granite, trimmed with Long Meadow stone, and is to be finished in fourteen months. The contractors agree to pay the county $1,700 for the old court-house, and it will be torn down as soon as the county officials can move the books and records to other quarters. There were thirteen bids for the whole contract and sixty-four proposals in all.

Dike.—The following is an abstract of proposals for constructing a dike in the Delaware river between Hog and Maiden Islands, received by Lieut.-Col. Henry Robert, Corps of Engineers, U. S. A., and opened May 26, 1886:

No.	Names and Addresses of Bidders	Approximate Quantities. Piles. 2,500 lin. feet. Per ft.		Brush Mattress. 3,600 c. yds. Per yrd.		Annealed Iron Wire. 5,500 lbs. Per lb. Cts.		Stone. 10,000 cu. yrds. Per yrd.		Total.
		Cts.								
1	John Satterlee, Englewood, N. J.	19	$475	$1.69	$6,084	4	$220	$1.49	$14,900	$21,679.00
2	R. Patterson & Son, Philadelphia, Pa.	14	350	1.53	5,508	3	165	1.38½	13,850	19 873.00
3	William M. Field, Wilmington, Del.	16	400	1.65	5,940	2½	137.50	1.39	13,900	20,777.50
4	Ira Lunt, New Castle, Del.	18	450	1.67½	6,030	5	275	1.44	14,400	21,155.00
5	John A. Bouker, New York, N. Y.	20	500	1.53	5,508	5	275	1.45	14,500	20,783.00

The bid of Robert Patterson & Son has been recommended for acceptance.

Dredging.—The following are the bids for 2,964 cubic yards of dredging in Portland Harbor, Maine: Robert Hamilton, Chebeague, Me., and Solomon Sawyer, Yarmouth, Me., 31 cents per cubic yard. Moore & Wright, Portland, Me., 28 cents per cubic yard. The latter was the successful bid.

Bridges.—The following bids were received by the Minneapolis, Minn., Council Committee for building a bridge over Bassett's creek: John Devereaux, masonry, per yard, $7; rip rap, $2.25; piling, 30 cents; lumber, $20; iron railing, $25. Thomas Daly, masonry, $6.45; lumber, $18; piling, 36 cents. Ring & Tobin, masonry, $7.20; piling, 33 cents; lumber, $20. Thomas Daly being the lowest bidder, it was decided to thus make him the award.

The engineer presented plans for a wooden bridge over Bassett's creek, near Upton street, which it was estimated could be built for $800, and would stand eight years. The bridge was offered as a substitute for a stone arch bridge, the cost of which was estimated at $8,000. It was thought that the cheaper bridge would do until a better one could be built.

Grading, Paving and Curbing.—The following bids were recently opened at the Mayor's office, Baltimore, Md.:

	Grading. per cu. yd.	Paving. per sq. ft.	Curbing. per lin. ft.
	cents.	cents.	cents.
Morgan & Bresnan	15	5½	40
Thomas F. Locke	5	5	36
Patrick Reddington	15	5	40
Wm. D. Smith	15	5¼	39
A. Snyder & Son	14	5½	40
Owen Patterson	12	5	38
James P. McGovern	18	5½	40
William Smith	10	4¾	40
J. T. Holbrook	15	5½	45

The contract has been awarded to Thomas F. Locke.

Cincinnati Chamber of Commerce.—The fifty-seven bids were opened on the 17th inst. There was but one bid for the entire work, that of Norcross Bros., Boston. The awards were as follows:

Excavation and masonry, J. H. Finnegan & Company	$51,999.00
Brickwork, J. M. Blair & Sons	39,815.00
Stone cutting, Hallowell Granite Co	127,686.00
Stone-carving, Evans & Tombs	42,455.00
Fire-proofing, Chicago Fire-proofing Co	31 000.00
Plastering, Pugh & Stagge	8,973.00
Floor tiling, Bonner, Lancaster & Co	2,265.20
Iron work, Fred J. Meyers M'f'g Co	105,500.00
Skylights, Witt & Brown	4 360.00
Sidewalk lights, M. Clements	3,000.00
Brasswork, Fred J. Meyers M'f'G Co	1,575.00
Carpenter work, Jas. Griffith	39,768.00
Electric bells, Billings & Merkhofer	1,475.00
Roofing, Jas. Hunter	8,350.00
Painting, G. W. Thorpe	3,500.00
Plumbing and gas-fitting, Murphy & Atkinson	20,770.00
Heating and ventilation, Eisenhofer & Malcolm	24,454.00
Elevators, Crane Elevator Co., Chicago	14,600.00
Total	$531,545.20

Street Paving.—The following bids have been received by the New Lots Improvement Commissioners for paving Atlantic avenue in East New York: K. A. Murphy, granite blocks, $2.73 per square yard; palisade granite, $1.89; New York Belgian blocks, $1.64; Staten Island Belgian blocks, $1.49. Austin & Gary, granite, $2.48; Belgian block, $2.30. Patrick Farrell, granite, $2.57; Belgian block, $2.14. John McNamee, granite, $2.55; trip blocks, three sizes, $2.50, $2.10, $1.85. James F. Gillen, granite, $2.43; Belgian block, $1.87. Charles Hart, granite, $2.59; Belgian block, $1.37. At the meeting of the Commissioners on Monday, granite block paving was decided upon, and the contract awarded to James F. Gillen. The totals of bids for granite were as follows:

K. A. Murphy	$100,671
Patrick Farrell	96,215
Charles Hart	95,346
Austin & Gary	93,920
John McNamee	93,395
James F. Gillen	90,970

Figuring on 35,000 square yards of pavement, 500 lineal feet of new curb, 400 lineal feet of new bridges, 250 lineal feet of new culvert and 6,500 lineal feet of curbing, the total cost of the improvement will be between $75,000 and $100,000.

Railroads, Bridges and Canals.

The International Conference for establishing a uniform technical railway system, was opened at Berne, Switzerland, on May 10.

The North Arkansas Railway Company has been incorporated. The road will run from Ravendon Springs to a point north. The capital stock is $250,000. The road will be pushed rapidly to completion.

The Panama Canal.—PARIS, May 26.—The Technical Commission sent to inspect the route of the Panama canal unanimously report that there is no obstacle in the way of constructing the canal without locks.

Iron Bridge.—The Highway Commissioner, Fort Hunter, N. Y., has been authorized to construct an iron bridge across the Chuctanunda creek. Cost not to exceed $2,000.

The Chinese Admiralty.—The Chinese Government are taking steps to make their new Board of Admiralty an important department. Prince Chun, its President, has been authorized to raise the sum of five million taels, about $7,500,000.

The Arthur Kill Bridge.—The Senate has passed the bill authorizing the B. & O. R. R., to build this bridge. The amendment to increase the height at the channel from 32 to 70 feet was defeated, as was also the amendment to substitute a tunnel for the bridge. The House has concurred.

The Ohio River Railroad Company has filed two mortgages, for $2,000,000 and $1,500,000 respectively, to the Fidelity Trust and Safe Deposit Co. of Philadelphia. The loan is for the purpose of taking up the bonds issued in May, 1883, amounting to $1,295,000, and also to build the extension from Parkersburg to Point Pleasant, W. Va.

The Ohio River and Lake Erie Railway's rights and franchises were seized at Erie, Pa., May 25th, at the suit of E. W. Reed, of Erie, and the First National Bank of Conneautville, and on executions amounting to $66,000. The roadbed is built but no rails are laid. The track was being built on the line of the old Erie canal, and was to have been a connecting link between the Baltimore and Ohio system and the great lakes at Erie. The road has been in ill luck from its start. First a subcontractor failed, and the laborers had to seek the charity of the Mercer Alms-house. Then the President failed a couple of months since. President Reed says the difficulty will be amicably arranged.

The Rochester, Hornellsville and Lackawanna Railroad Company has been organized at Hornellsville, to build a link from Hornellsville to Canaseraga, on the Lackwanna and Pittsburg R. R. Receiver Chapman and other officials of the latter road have agreed that if the citizens will furnish the right of way and $60,000, they will complete the road within six months from the time the right of way is secured. The road must be built and regular trains running before any money is paid in by the subscribers. Already $20,000 of the required amount has been secured. The only road now touching Hornellsville is the Erie.

Reading and Lebanon R. R.—The stockholders of this company, which has a line surveyed between the two cities named, and expects to begin work upon it at an early date, held their annual meeting at Reading, Pa., May 11th, and elected the following officers: President, William M. Kaufman, of Reading; Secretary, William G. Moore, of Womelsdorf; Treasurer, Charles McFadden, of Philadelphia; Directors, Charles McFadden, William G. Moore, James W. Deppen, of Wernersville; John M. Shonour, of Womelsdorf; Jacob Behney, John A. Donges and Joseph Coover, of Myerstown; Adolphus Reinshel, of Lebanon. The new line will connect with the Pennsylvania Railroad.

New Jersey's Capitol.—TRENTON, N. Y., May 25.—The Capitol Rebuilding Commission decided to-day that all the dark stone necessary to be used in the new structure shall be obtained from Williamson's quarries, near Sergeantsville, in Hunterdon county. The Commissioners have been supplied with numerous samples of light stone for use in the body of the building, but no selection has been made, because of the great difference in the cost. The commission will choose four or five samples of the most desirable stone and invite proposals. The talk about removing the interior foundation walls, which were erected last autumn, amounts to nothing. Because some of the bricks on the outside were loosened by the action of the weather it was stated that the walls were flimsy and would not hold the proposed superstructure. Andrew J. Post, inspected the walls last week, and pronounced them substantial.

E. T., Va. & Ga. R. R.—All the property belonging to the East Tennessee, Virginia and Georgia Railroad Company was sold under decree of foreclosure in Knoxville, Tenn., May 25th, and it was bid off by E. F. Hyde, representing Messrs. Brice, Thomas, Seney, McGhee, and others, members of the reorganization scheme, and principal holders of the first mortgage and consolidation income bonds. The amount paid was $1,250,000, with $100,000 cash down. The 1,200 miles of road originally cost about $30,000,000, and was bonded for $87,000,000. The road was placed in the hands of Henry Fink, Receiver, at the instance of the Central Trust Company, January 6, 1884. Mr. Fink will be President under the new organization, which will be effected about July 1st. It is understood that $70,000,000 worth of new bonds will be floated at once to satisfy holders of common stock, and to repair the roadbed, rolling stock, etc.

THE ROCKPORT R. R.

ROCKLAND, ME., May 24, 1886.

EDITOR ENGINEERING NEWS:

I wish to correct an error which has crept into your paper (in common with several other papers). I notice you say the "Rockport & Limerick R. R. has been incorporated," etc.

The name is the "Rockport R. R.," and the corporators are residents of Rockport (in the town of Camden). The articles of association were approved by the R. R. Commissioners, May 17, at a meeting held in this city.

I completed the preliminary survey last week, and am now engaged on the office work. I am not yet able to give the time for the commissioners hearing for approval of location. Yours truly,

O. H. TRIPP.

Illinois Central R. R.—This well-managed undertaking has communicated to its proprietors a mass of valuable information as to the course of its affairs in 1885. It appears that the traffic receipts of the company last year were $12,621,264, as compared with $12,190,833 in 1884. The earnings of the lines owned by the company in Illinois and in the Southern States increased $464,485, but the earnings of the leased lines in Iowa fell off to the extent of $34,054. The net earnings of the company's system in 1885 were $4,776,189, as compared with $4,820,544 in 1884. Including accessory items of revenue, the balance available for interest and dividend was increased to $5,238,241. Of this sum the directors applied $594,400 to interest and sinking fund on bonds; $1,480,791 to the rent due for the Chicago, St. Louis and New Orleans system; and $548,859 to permanent improvements. After these deductions had been made, the balance available for dividend upon the share capital of the company was reduced to $2,614,190. Out of this balance, dividends amounting to eight per cent. were paid for 1885-6. These dividends absorbed $2,320,000, leaving $294,190 to be carried forward to the credit of 1886. The corresponding balance brought into the revenue of 1885 was $294,139, so that after paying eight per cent. upon the share capital the company just about held its own for 1885.

There is one remarkable feature in the Illinois Central, and that is the relatively moderate charge of the bonded debt, which amounted for the year to $594,400, to meet which the company had a balance of $5,238,241 available for interest and dividend. We fancy that there are few American railroad companies which have their bonded debts so well in hand as this. It may, indeed, be said that the bonded indebtedness of the Illinois Central is a mere bagatelle. Another good feature in the Illinois Central is its considerable allocation of revenue to capital for improvements. Most English companies—and for the matter of that, too, most American railroad companies—have a tendency to charge too much to capital and too little to revenue; but the Illinois Central has rigidly kept down its capital account, and is bringing up its existing lines to the necessary standard of efficiency by making considerable yearly deductions from revenue for that purpose.

The whole outlay for works upon the company's existing lines in 1885 was $619,297; and of this sum $548,859 was, as we have just shown, charged to revenue, so that the whole charge to capital for improvements in 1885 did not exceed $70,437. When account is taken of the fact that the Illinois Central accommodates districts which are steadily growing in population and wealth, the wise policy pursued by the Directors in keeping the capital account down to the most moderate possible limits must be admitted to be an extremely sound course, and one which is decidedly calculated to to increase the ultimate prosperity of the undertaking.

We have stated that the bonded debt of the Illinois Central is relatively moderate, and it may be well to add that the whole amount of bonds outstanding at the close of 1885 was $10,018,000; while the capital stock stood, at the same date, at $29,000,000. The Illinois Central has not been slow to take advantage of the cheapness of money and of the tendency to lower rates on railroad bonds in the United States generally; and it has now some four per cent. bonds outstanding which will not fall due until June, 1951. It has even succeeded in placing some three and one half per cent. bonds running to January, 1951.

It will not be possible for the directors to make much impression upon the company's existing bonds for some time to come, as no bonds mature until 1895. Moreover, it will be seen that with a bonded debt of only $10,000,000, a reduction of one per cent. all round involves an annual saving of no more than $100,000. We may, however, be quite sure that the Illinois Central directors will do all they can to keep the annual charges upon the undertaking within the narrowest possible limits. The Illinois Central is now working 2,056 miles of line. Its main lines extend from Chicago to Cairo and from Dunleith to Centralia; and with the help of a considerable number of branches, and the help also of the Chicago, St. Louis, and New Orleans, it has thoroughly tapped the resources of Dakota, Iowa, Illinois, Missouri, Kentucky, Louisiana, and Mississippi, so that it has become one of the most prosperous undertakings in the United States.—*Herapaths Journal.*

Newburg Street Railroad.—The franchise for the North Water-street extension was sold May 7, and was purchased by the Newburg Street Railroad Company.

The Missouri Valley, Bismarck & Southeastern Railroad Co. has filed articles of association at Bismarck, Dak. The incorporators are: J. C. Wedge, Fond du Lac, Wis.; Albert Phalen, Chicago; Byron Towne, Minneapolis;—Stoneman, Minneapolis; C. H. Peake Minneapolis; M. R. Ellis, Minneapolis; George W. Jenkins, Aberdeen, Dak.; G. M. Wing, Oriska, Dak.; A. S. Haines, Oriska, Dak. Capital stock, $5,000,000.

The Arkansas, New Mexico & Pacific R. R. Co. has been incorporated to construct a road from Fort Smith, Ark., westerly through the Indian Territory, along the course of the Canadian river to the Texas boundary and through the Panhandle of Texas into New Mexico as far as Albuquerque. The incorporators are: E. W. Cole, C. M. McGhee and Napoleon Hill, of Tennessee; John Parham and Jesse Turner, of Arkansas; Samuel Thomas and C. S. Price, of Ohio; Samuel Shethar, Frank Work, John T. Martin, J. G. Moore, E. R. Lyman and N. L. Terrell, of New York.

Market Street Bridge.—The Philadelphia Council has passed the ordinance appropriating $300,000 for building an iron deck bridge over the Schuylkill river at Market street. The bridge will be on the cantilever principle. There will be a central span of 214 feet 6 inches, two spans of 97 feet 6 inches and a shore span, on each side, of 60 feet; the total length of the bridge will be 555 feet. It will be 77 feet wide, composed of a 52-feet roadway for vehicles and the cable cars, and two sidewalks, 12 feet 6 inches each. The Chief Engineer and Surveyor has been authorized to employ additional engineering skill to ascertain whether the piers of the old bridge now standing can be safely used as supports for the new structure.

Niagara Falls and Whirlpool R. R.—The completed survey appears to have upset a theory as to the incline of the Niagara river from the falls to Suspension Bridge. A gentleman who recalls the building of the Great Western Railway and the Suspension Bridge, about 1852, states that a survey of the bank at that time convinced engineers that the river actually ran up hill, or, in other words, that the river bed was 4 feet higher at the Suspension Bridge than at the falls. The current was accounted for by the supposed great pressure of the water as it came over the falls. The present survey shows that there is a fall of 6 feet from the foot of the American fall to the cantilever bridge, and that the last mile of the grade, which ends at the whirlpool, has a decline of 54½ feet.

New York Legislature.—The Assembly has passed the following bills: appropriating $5,000 for improving the navigation of Saugerties creek; establishing pier lines on the Brooklyn shore of the East river; authorizing the construction of a bridge over the Erie canal at Buffalo; for rebuilding bridge over the Erie canal at Rochester; allowing the Catskill Mountain R. R., to charge ten cents per mile; authorizing Utica to issue paving bonds; and authorizing the sale of the Jubilee water-works, Buffalo. The Senate has passed the following bills: appropriating $33,000 for the Cohoes and Waterford bridge; appropriating $7,000 for a canal bridge at Rochester; Yonkers sewer; Poestenkill bridge; and Mortezuma State ditch. The following bills have received the Governor's approval: ratifying proceedings relating to the construction of a bridge over the Susquehanna river in Broome county; appropriating $3,000 for cleaning Mill creek; and relating to railroads in Buffalo.

A Railroad Bridge in Hartford.—HARTFORD, CONN., May 24.—The question of building a bridge over the Asylum-street railroad crossing, in this city, has been agitated in the City Council and Legislature for the past three years. The latter body appointed a commission, with power to fix a plan and compel the roads to pay one-half the cost, including land damages. The commission adopted the so called West Side plan, to cost probably $400,000, and two weeks ago applied to Judge Carpenter to appoint appraisers for condemnation of land. To-day the respondent land-owners filed objections and raised several legal questions, the chief of which is that the legislative act obliging the city to share in the cost violates the constitutional amendment of 1877 prohibiting any county, town, borough, or city from making any donation to a railroad corporation. The matter will come up for a hearing June 5 Independent of this legal controversy, which is in shape so that a long fight can be carried on in the courts, the New York, New Haven and Hartford, and the New York and New England railroad companies, by their Presidents, memorialized the Common Council to night to be heard later on a proposition to build a bridge on what is known as the South Side plan, and to bear the entire cost and the expense of repairs for all time, provided the city will give the right of way. The acceptance of this offer will save the city at least $125,000, as the right of way will cost not exceeding $20,000. The plan proposed is one which the City Council originally approved.

Pontiac Pacific Railway.—Contracts are now let on the Pontiac Pacific railway as far as the first crossing of the Ottawa at LaCasse, a distance of about sixty miles. Forty-one miles are completed. It is expected that the whole line to Pembroke will be finished by October 1st.

The Werribee Viaduct, the longest work of its kind in Australia, has been tested. It is a lattice-girder structure, 1,230 feet long, and 125 feet above the level of the Werribee river. The bridge consists of fifteen spans of 60 feet each and thirteen spans of 30 feet, and cost $600,000. The test was highly successful.

Canadian Railroads.—The Canadian Blue Book, showing the returns of railroads in Canada for the year ending June 30, 1885, has recently been issued. The total miles of track laid were 10,773, against 4,929 in 1876, and the total miles in operation, 10,150. The total number of passengers carried was 9,672,699, the total freight tonnage, 14,659,271 tons, and the total number of miles run by trains, 30,623,687. The comparative statement given indicates great development of the country resulting from the railway system. The miles of completed railway have in ten years increased 118 per cent. The amount of capital invested has increased 48 per cent. The gross earnings show an increase of 66 per cent. and the net earnings an increase of 130 per cent. The number of passengers carried increased 76 per cent. and the tons of freight 130 per cent. The miles of railway at the beginning of the present year amounted to 11,216, the increase being caused by the completion of the Canadian Pacific R. R., the Gravenhurst & Callendar R. R. and the extension of railways in Manitoba and the northwest.

Northern Pacific R. R.—Washington Territory papers report that the temporary line at the Cascade tunnel will not be an ordinary switchback, but will be built on the rack-rail system. It is stated that the road on this system will be much shorter and can be more cheaply built. It is expected that this temporary line will be in use for about two years. At the west end of the Cascade tunnel the heading is in 67 feet, and the east heading is in 279 feet, both being in very hard rock. The work will have to be prosecuted entirely from the headings, as the mountain is too high to permit of the sinking of shafts. Charles B. Wright, of the Northern Pacific, stated recently that the switch-back on the Cascade branch would be completed and through trains be running from St. Paul to Tacoma before next Christmas, and perhaps as early as November. W. H. Kennedy, who was recently assigned to engineering work on the west side of the Cascades, has found it practicable to build a tunnel on an easy grade and save a large amount of expense by building a loop.

St. Louis Cable Railroad.—The company commenced business April 15, beginning with only six trains. This has been gradually increased, until now the management is enabled to place upon the line from eighteen to twenty trains at a time. During the first three weeks the defective castings in the pulleys, and the unsatisfactory work of the grips, etc., caused many delays and stoppages, so that it was impossible to make regular trips or run the desired number of cars. This difficulty was to be expected, as in the starting of all cable lines in other cities much greater obstacles had to be overcome. Superintendent Branham now feels that he is master of the situation, and will soon overcome all the difficulties. The general construction of the road, its machinery and equipment is first-class in every respect. The result of the twenty-seven days' business of the cable line, ending the 11th instant, is the daily average of nearly 12,000 passengers. Under the circumstances this is regarded as an excellent showing Now that everything is working, and with increased facilities, the earnings from this division will materially enlarge, with the improvements ordered for the steam division in the way of new steel rails, ties, cars and locomotives and the completion of the elegant transfer station, engine-house, machine shops, etc.

A Great Blasting Operation.—A great blast was recently fired on the works for enlarging the tidal basin of the Royal Albert Dock, London, England, to remove a solid concrete wall on the northeast side of the basin. The wall had been reduced in thickness to 4 feet 6 inches at the top, and at the bottom to 6 feet, was pierced with 1,430 holes about 4 feet apart, and these were loaded with charges of gelatine dynamite, varying from eight pounds at the base, to three-quarter pounds at the top. All these charges were put in at the back of the wall, its front remaining intact and supporting the water in the basin. The total length of the wall was 520 feet, and the estimated weight of material 7,850 tons. The electrical wiring was carried out by Messrs. Siemens. The total length of branch wires was over six miles, and the total quantity of gelatine dynamite employed was 2,860 pounds. The early hour of six in the morning was selected for the operation. After three separate soundings of a bugle call, a large cartridge was exploded on the surface of the water, as a final signal and in a few seconds a sheet of foaming water burst about 20 to 30 feet into the air, with broken piles and débris, a thinner sheet of fine spray rose higher still, and a blue mist rose over all. A wave about 2 feet high flowed across the basin, the water being filled with bubbles of air driven out by the compression of the muddy bottom. The result of the blast was satisfactory, the wall being entirely destroyed with the exception of a few large blocks.

Lake Shore & Michigan Southern R. R.—The following table of gross and net earnings and dividends earned and paid for sixteen years is of interest, not only to the Lake Shore stockolders, but to the financial community generally:

Year.	Gross Earnings.	Net Earnings.	Dividends per share of $100 Earned.	Dividends per share of $100 Paid.
1870.....	$13,509,236	$5,140,415	$9.60	$8.00
1871.....	14,898,449	5,118,643	8.37	8.00
1872.....	17,699,935	5,860,409	8.55	8.00
1873.....	19,414,509	5,667,911	8.10	4.00
1874.....	17,146,131	5,999,769	6.04	3.25
1875.....	14,334,199	4,902,698	2.20	2.00
1876.....	13,949,177	4,374,341	3.26	3.25
1877.....	13,505,159	4,541,193	3.57	2.00
1878.....	13,979,766	4,494,165	5.61	4.00
1879.....	15,271,492	6,336,968	7.24	6.50
1880.....	18,749,461	8,331,356	11.98	8.00
1881.....	17,971,391	6,692,902	8.02	8.00
1882.....	18,225,639	7,167,832	8.37	8.00
1883.....	18,513,656	7,511,802	8.11	8.00
1884.....	14,843,585	5,710,062	4.02	5.00
1885.....	14,133,506	4,845,969	1.98	....

It will be noticed that in every year from 1870 to 1883 inclusive, the dividends earned were in excess of those paid, the balance having gone into construction and betterments, thus adding to the value of the property. In 1884 the dividends paid were slightly over the amount earned, and in 1885 no dividend was paid, although the statement showed 1.98 per cent. on the stock. The floating debt, however, was reduced, the premium on bonds sold giving a large sum for this purpose.

The freight movement for sixteen years shows in a clear light the steady reduction in the cost of transportation by rail in this country, which has been brought about largely by competition and legislation. The profit realized by the Lake Shore per ton per mile in 1885 was the smallest for any one year since 1870, and for that matter the smallest ever obtained. The table annexed, as well as the preceding one, shows plainer than words, that 1885 was about the worst year in the history of the great trunk line roads:

Year.	Tons moved one mile.	Receipt per ton per mile. Cent.	Cost per ton per mile. Cent.	Profit per ton per m'e. Cent.
1870.....	574,035,571	1.504	.932	.572
1871.....	733,670,696	1.391	.913	.478
1872.....	924,844,140	1.374	.920	.454
1873.....	1,053,927,189	1.335	.946	.389
1874.....	909,342,081	1.180	.767	.413
1875.....	943,236,161	1.010	.737	.273
1876.....	1,133,834,826	.817	.561	.256
1877.....	1,080,005,561	.864	.573	.291
1878.....	1,340,467,821	.734	.474	260
1879.....	1,733,423,440	.642	.308	.344
1880.....	1,851,166,018	.750	.435	.315
1881.....	2,021,775,468	.617	.414	.203
1882.....	1,892,868,224	.628	.413	.215
1883.....	1,689,512,415	.728	.452	.276
1884.....	1,410,545,674	.652	.426	.226
1885.....	1,602,567,035	.553	.399	.154

Iron Furnaces to be Built in Alabama.—PHILADELPHIA, May 23.—The Thomas Iron Company of this State, which operates in the Lehigh Valley, is interested in several thousand acres of the best ore land in the vicinity of Birmingham, Ala. It is the purpose of this company in conjunction with other capitalists of this State to develope these lands. With this end in view the money has been subscribed to erect two furnaces on these Alabama lands, one of which will be built immediately at a cost of $1,000,000. This will be one of the largest blast furnaces in the country, and will have a capacity for making twelve hundred tons of pig iron per week. It is estimated that the production of pig iron in such large quantities will cheapen its cost to such an extent that after the payment of freight it can be placed in this market at a price $2.50 per ton lower than the irons of this State can be sold for. It is stated, however, by the gentlemen who have undertaken this enterprise that they do not contemplate coming into the northern market with the product, as they have evidence that the south will need all the iron that is produced within its borders. Enterprises under consideration in the south and southwest next year include bridges, railroads and many other things into which iron enters that will absorb an enormous yield. The production of the new furnace is to be of the best, and will command a market readily. The second furnace will be built by the same capitalists about six months after the completion of the first, and is to cost about the same amount of money. The iron trade here is sometimes embarrased even now by southern made irons offered at prices fifty cents lower than the regular market price. These irons are brought as ballast by vessels which are loaded with cotton.

Engine Building on the Consolidated.—Since Mr. Henney went to New Haven and assumed charge of the shops of the Consolidated road, the engine stock of the road has taken another step towards the perfection which it is desired to reach in each engine of the road. A reporter of the *Palladium* has made a visit to the shops at New Haven and learned a number of facts which will be read with interest. He writes:—

Passenger locomotive No. 131, now under construction at the locomotive shops of the Consolidated road in this city, is intended to be one of the finest machines ever turned out in this line of industry. Her boiler was placed this week, and the numerous parts of the big machine are assuming finished outlines. When her coal and water receptacles are filled, No. 131 will weigh seventy-five tons. No heavier machines are on the Consolidated road, with the exception of four or five ten-wheelers built for freight haulers by the Rhode Island Locomotive Works of Providence. These machines, which appear much more ponderous than express engines such as No. 131 will be, are really only five tons heavier. This is due to their shorter tenders. The first-class express engines built in this city have tenders with capacity for 3,000 gallons of water, while the big Providence moguls carry only 2,500 gallons. All the new class of express engines are exact duplicates, and the parts of any one can be used on any other. If an engine becomes disabled, she is side-tracked and duplicates of the broken machinery are sent from the shops in this city, thus allowing the disabled fiver to run as usual in a few hours. The locomotive that has been deprived of one or more of her many parts, waits in the shops until new parts are built. This does away with the necessity of having a crippled engine laying off down the road until her broken parts are renewed. The express engines now built in this city have driving wheels of a diameter of 5½ feet. One of the officials when asked recently if these drivers were superior to six foot drivers replied: "The six foot drivers are out of date now. We have four machines with them still in use, however, No. 5, No. 6, old 27 and 33. No. 27 is thirty years old, and is running our stone train. She is a Paterson engine. The other three we use on light passenger trains. Our grades are too heavy for six foot wheels, which do nicely on a level road, as an engineer does not have to run his machinery so fast to obtain the same speed as he would on a five and a half foot wheel. What a six foot driver gains on a level run, she loses on an up grade. The Pennsylvania road uses the six foot wheels on many of its limited trains, but their limited express trains of five cars are not like our big express trains of seven, eight and nine cars."

It also appears that engines built by the Consolidated road have run 80,000 miles in twelve months and lost only three days. Four or five years ago it was thought 32,000 miles a year was all an engine could be counted upon for. The new engines cost more to build than others could be bought for, but they repay their cost in efficiency and durability.

Canadian Pacific Railway.—Fifty one tenders were received by the Canadian Pacific Railway Company for the building of that portion of the Ontario & Quebec line which is to shorten the distance between Montreal and Toronto about thirty-six miles. Up to Friday, the 14th inst., at noon, tenders were handed in.

The following are the successful bidders: Messrs. W. Buehner, Hutchinson, Wood and Molesworth, John Drew, T. & J. Robinson, Corbett & Skead, Breen, Connolly, Begge & McMahon, J. & W. G. Elliott, Fauquier & Dinwoodie, Davis Bros., Ross & Holt.

The new line is popularly called the Smith's Falls road. At Smith's Falls it merges into that portion of the Ontario & Quebec road built in 1883 and 1884, and when completed will constitute the shortest possible route between the commercial metropoli of the two great provinces of the Dominion.

The distance traversed by the new line from Montreal to Smith's Falls is about 126 miles, it will pass through the counties of Soulanges, Vaudreuil, Glengarry, Stormont, Dundas and North Grenville, until it strikes the original Ontario & Quebec portion. The road will run either through or close by the following towns and settlements westward from Montreal: Lachine, Point Clare, Dorval, St. Anns, Vaudreuil, St Dominique, Des Cedris, St. Clet, Point Chateau, St. Polycarpe, St. Telesphore, Peveril, Glen Norman, Glen Nevis Glenroy, Green Valley, Loch Garry, Apple Hill, Gravel Hill, Monkland, Avonmore, South Finch, Chesterville, West Winchester, Vancamp Mills South Gower, Hallville, Kemptville, Oxford Mills, Merrickville, Montague and Smith's Falls. It crosses the Ottawa river at Vaudreuil, and the Rideau river at Merrickville, intersecting the St. Lawrence & Ottawa Railway at a point about eighteen miles east of Smith's Falls. From Vaudreil westward the new line diverges steadily to the north from the Grand Trunk to the we tern end, where the roads are about twenty seven miles apart. The Grand Trunk skirts the St. Lawrence, while the continuation of the Ontario & Quebec Railway runs almost centrally through five Ontario counties above named, and will afford convenient and valuable railway facilities to towns and settlements in the interior which have heretofore had only distant and expensive connection by wagon roads to a railway.

The work of construction has been divided into twenty-six sections, varying from four to six miles, and the stations run from zero to No. 5,555. It is estimated there will be clearing to be done of 437 acres only; of close cutting about fifty acres; grubbing, 67 acres; cross-waying, 10 acres. 1,658,000 cubic yards of earth in cuts and fills will have to be handled, together with about 23,000 cubic yards of loose rock, while 87,600 cubic yards of solid rock will call into play hundreds of tons of steel and vast quantities of the most powerful explosives. At Vaudreuil and St. Ann's alone there will be about 11,000 cubic yards of first-class masonry, but over the whole line not more than 20,000 will be used; while of second-class the company intend putting in only about 1,100 cubic yards. Of box culverts there will about 1,700 cubic yards. 1,218,000 superficial feet of lumber, it is calculated, will be wanted for culverts and cattle guards. In bridges nearly a million feet will be used, and 34,000 lineal feet of piling must be driven. The road will be first class in every particular when completed, and so constructed as to render a speed of forty or fifty miles an hour safe and comfortable. The aim is to make the run between Montreal and Toronto two hours less than at present. Some of the work is to be completed by August 15th next, some by September 1st and 15th, and the whole by the 15th of October this year.

Mr. H. L. Lumsden, C. E., will be the chief engineer for the 102 miles from Vaudreuil to Smith's Falls, while Mr. P. A. Peterson, C. E., will have charge for the twenty-four miles from Montreal to Vaudreuil. Mr T. J. Shaughnessy will be manager of the construction throughout.

Market Report of Engineering Materials.

New York May 27, 1886.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.		
Angles	2.00c	@ 2.10c
" steel	2.35	@ 2.45
Tees	2.40	@ 2.45
Beams and channels, American	3.0	@
Tank Plates	2 13	@ 2.20
Shell Plates	2.4	@ 2.5
Steel plates, Tank	2.70	@ 2.75
WROUGHT-IRON PIPE. PITTSBURG.		
Butt welded, black Discount		48
" " galvanized "		35
Lap welded black "		60
" galvanized "		42½
Boiler tubes "		52½
RAILS.		
Steel (large lots at mill)	$34.50	@ $35.00
Old rails	18 50	@ 19.00
Old rails, steel	22.00	@ 23.00
B. B. spikes	2.15c	@ 2.25c
B. B. splice-plates	1.70	@ 2.00
B. B. track bolts, square nuts	3.00	
Barb-wire fencing, galvanized	4.38	
" " painted		4.00
Corrugated iron		
Nails		
Iron, per keg	2.00	@ 2.15
Steel do.	2.55	@ 2.60

METALS.

COPPER.		
Lake Superior	10.00	
Other Brands	9.50	@ 9.75
LEAD.		
Com. Domestic	4.70	
Lead Pipe	.06¼c.	
Tin-Lined Lead Pipe	.15	
Sheet Lead	.07¼	
ZINC.		
Sheet	$5.50	@ 5.70

BRICK.

Cargoes (afloat)		
Haverstraw per M.	7.00	@ 7.75
Fishkill	6.75	@ 7.00
Up-River	6.25	@ 6.75
Jerseys	5.75	@ 6.25
Long Island		
Pale	4.25	@ 4.75
FRONTS.		
Croton, red	12.00	@ 15.00
" dark	12.00	@ 15.00
" brown	11.00	@ 14.00
Philadelphia pressed	24.00	@ 25.00
Trenton "	24.00	@ 25.00
Baltimore "	37.00	@ 42.00
Buff "	33.00	@ 35.00
Enameled English	$35.00	@ 130.00
" American	80.00	@ 120.00
Fire brick	24.00	@ 55.00

CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be wholesale in New York, subject to such special rates as large quantities may warrant:

Alsen's Portland Cement Works	$2.50	@ $3.00
BAETJER & MEYERSTEIN:		
Hanover Portland	2.60	@ 2.65
BELLONI & Co.:		
Hemmoor "Crown" brand		2.50
JAMES BRAND:		
K. B. & S.	2.55	@ 3.00
BROOKS, SHOOBRIDGE & Co.	2.45	@ 2.60
HOWARD FLEMING:		
Gibbs' English Portland, 400 lbs.	2.50	@ 2.75
K. B. & S. "	2.65	@ 3.00
Stettiner, German	2.65	@ 2.85
Lagerdorfer, "	2.45	@ 2.75
Fieve, A 1, Belgian	2.35	@ 2.50
Roman	2.75	@ 3.00
Keene's Coarse	4.75	@ 5.50
" Fine	7.75	@ 8.50
" Superfine	8.50	@ 10.00
FISHER, ERSKINE W.:		
Stettin (German) Portland Cement	$2.40	@ 2.75
GABRIEL & SCHALL:		
Vorwohler "Lion"	2.65	@ 3.10
HUDSON RIVER CEMENT Co. Rosendale		0
JOHNSON & WILSON:		
Saylor's American Portland	2.15	@ 2.40
LESLEY & TWINELL, Philadelphia, Pa.:		
"Giant" Portland	2.20	@ 2.40
Improved "Union"	1.25	@ 1.50
Union	1.10	@ 1.20
MARCIAL & Co.:		
J. B. White & Bros. Coarse Keene's	4.25	@ 4.50
" Superfine	7.25	@ 7.50
" Portland	2.45	@ 2.85
NEW YORK CEMENT Co.:		
Rosendale		1.10
N. Y. & ROSENDALE CEMENT Co.:		
Rosendale, "Bridge" brand		1.10
SINCLAIR & BAUSON:		
K. B. & S.	2.35	@ 2.60
STANDARD CEMENT Co		
E. THIELE:		
Dyckerhoff	2.90	@ 3.25
UNITED STATES CEMENT Co.:		
Windsor	1.00	@ 1.10
Standard		1.15
Cube Portland	2.15	@ 2.40
UNION AKRON CEMENT Co.:		
Akron "Star" brand,		

ASPHALT.

ROCK.		
Prices range per ton	$15.00	@ 20.00
According to quantity or brand, and whether taken from vessel or store.		
PAVEMENT.		
Barber's Asphalt	$2.50	@ $3.50

LIME.

Rockland, common per bbl	1.00	
" finishing	1.20	
State, common	.90	
" finishing	1.10	
Kingston, ground	.95	@ 1.00
Add 25c. to above figures for yard rates.		

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.98	@ 1.00
" " No. 2 "	0.75	@ 0.85
" " light drab "	0.80	@ 0.95
Berlin " in rough "	0.75	@ 1.00
Berea " " "		
Brown stone, Portland, Ct. "	1 00	@ 1.35
" Belleville, N. J. "	0.75	@ 1.35
Granite, rough	0.45	@ 1.25
Common building stone per load	2.00	@ 3.00
Base stone, from 2¼ to 6 ft. lengths, per lin. ft.	0.40	@ 3.00

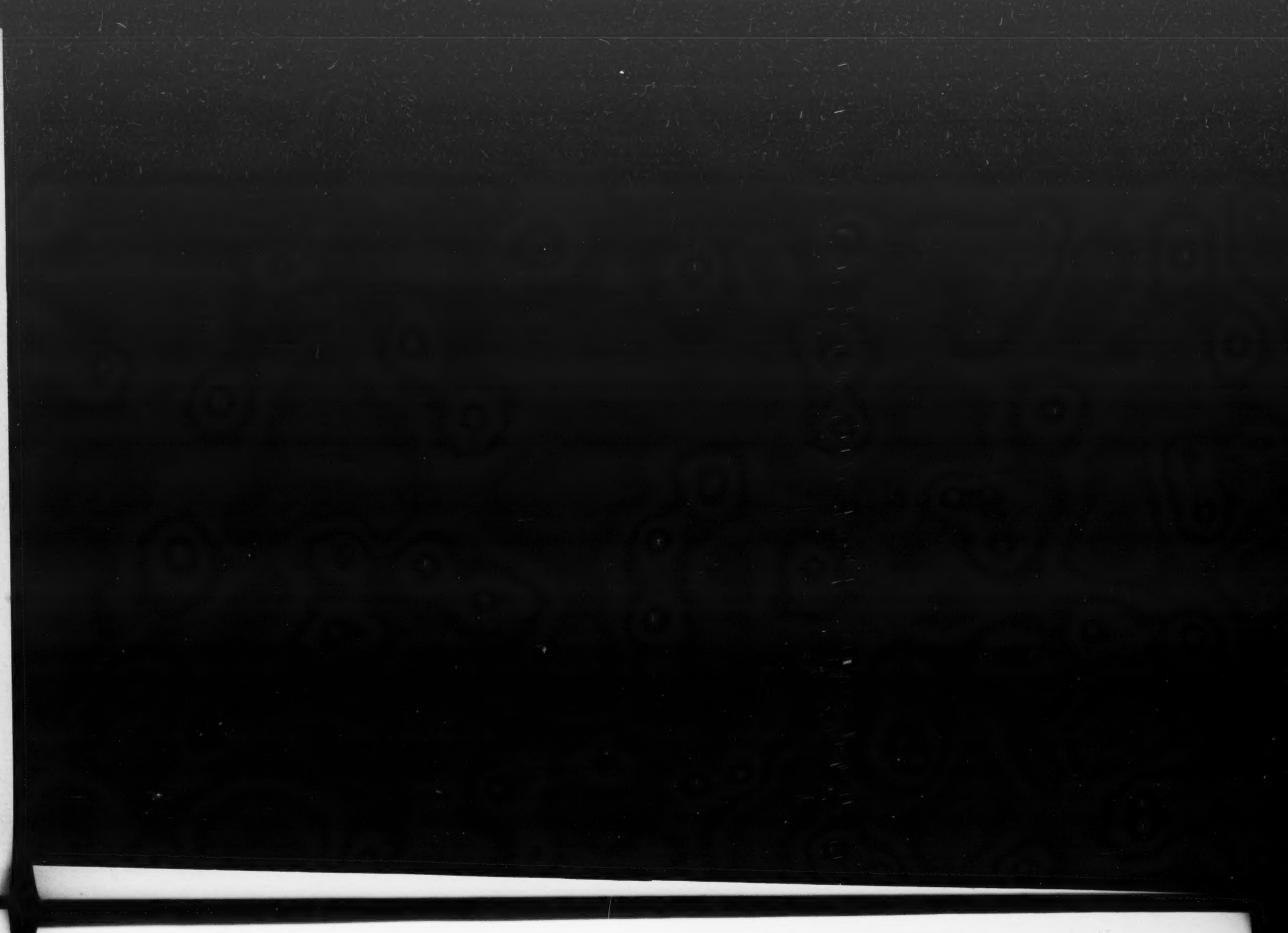
SLATE.

Purple roofing per square	6.00	@ 7.00
Green "	6.00	@ 7.00
Red "	15.00	
Black Penns. (at New York) "	4.50	@ 5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box per M.	18.00	@ 20.00
" Choice "	65.00	@ 70.00
Tally plank, 1¼ in. 10 in. dres'd. each.	.44	@ .50
Tally boards, dressed com. "	.28	@ .30
SPRUCE, Boards dressed "	.25	@ .28
Plank, 1¼ in "	.28	@ .30
" 2 in. "	.38	@ .40
" 2 in. dressed "	.43	@ .45
Timber per M.	13.50	@ 16.00
HEMLOCK, Boards each.	.18	@ .20
Joist, 2¼ × 4 to 4 × 6 in	.16	@ .44
OAK per M.	55.00	@ 65.00
CYPRESS 1, 1¼, 2 and 2¼ in "	35.00	@ 40.00
YELLOW PINE, Girders "	28.00	@ 30.00
Dressed flooring "	28.00	@ 35.00
SHINGLES, Extra shaved pine, 16in. "		
" sawed 18 in. "	5.75	@ 6.00
LATH, Cargo rate	2.25	@ 2.40

PAINT.

Lead, white, American dry per lb	.04¾	@ .06¼
" " in oil pure "	.07	@ .07½
" English, B. B. in oil "	.08¾	@ .08¾
" Red, American "	.05½	@ .06
Litharge "	05½	@ .06
Venetian red, American "	.01	@ .01¾
Indian red "	.08	@ .10
Vermillion, American lead "	.10½	@ .11¾
Paris green "	.15	@ .18
Umber, Amer. raw and powdered per lb.	.01¾	@ .01¾
Drop black, Amer.	.07	@ .13
" " Eng.	.11	@ .13
Chrome green	.10	@ .25
Oxide zinc, American	.03½	@ .03¾
" French	.05½	@ .07½